LONDON SHOW REVIEW . 1953

AUTOMOBILE ENGINEER

DESIGN · PRODUCTION · MATERIALS

Vol. 43 No. 573 **NOVEMBER 25, 1953** PRICE: 3s. 6d.



DURALUMIN

REGD. TRADE MARK

TRANSPORTS WET FISH

The use of 'Duralumin' in this container for brine soaked fish illustrates another interesting application of the corrosion-resisting properties of this aluminium alloy which is strong as steel but only one third of the weight. Our Development Department is always glad to advise, entirely without obligation.

Illustration by courtesy of the owners, Ross Group Ltd., and the builders, Duramin Engineering Co. Ltd.

BOOTH BIRMINGHAM

JAMES BOOTH & COMPANY LIMITED · ARGYLE STREET WORKS · BIRMINGHAM 7

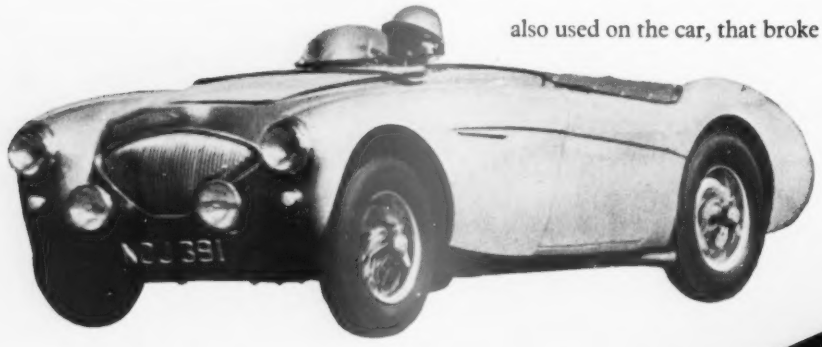
V.B.12A.

TO CROWN A YEAR OF BRITISH SPORTS CAR ACHIEVEMENT

THE **AUSTIN-HEALEY** TOOK MORE THAN 100 NEW RECORDS* IN 10 DAYS including 11 International Class D records and the Flying Mile Class D at 142.626 m.p.h.

MINTEX BRAKE LINERS AND MINTEX CONE LINERS for the Laycock-De Normanville overdrive are standard equipment on every Austin-Healey. In addition Mintex clutch liners were also used on the car, that broke the International records.

*Subject to official confirmation



When high performance counts—you can rely on **MINTEX**

MINTEX Brake and Clutch liners are manufactured by British Belting and Asbestos Ltd., Cleckheaton, Yorkshire. All MINTEX products are obtainable from MINTEX Service Depots and Stockists throughout Great Britain and the World. B.B.A. are also the manufacturers of 'Scandura' the original P.V.C. Fireproof Conveyor Belting.



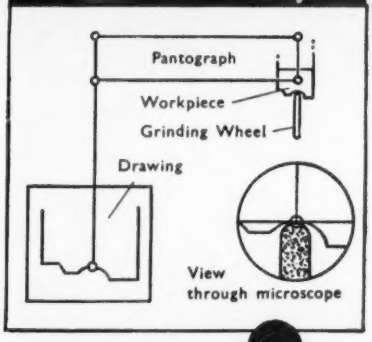
Wickman

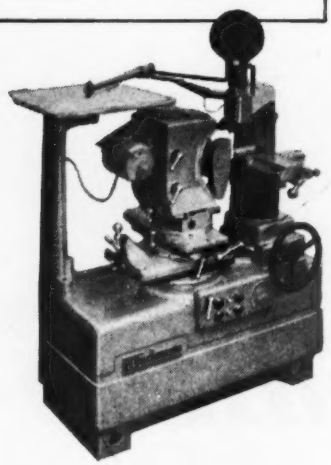
Optical

PROFILE GRINDING MACHINES

increase output in the up-to-date toolroom

A fifty-to-one drawing of the desired profile is mounted on the drawing table of the machine, and is used in conjunction with the pantograph system. The pantograph imparts a fifty-to-one reduction to its final arm in which is incorporated the projection unit.
Work is focussed under the microscope, and the tracing point of the pantograph moved along the drawn profile. The grinding wheel is fed manually into the work and the exact progress of grinding can be followed in the field of the projection screen or microscope.





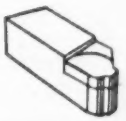
These machines are currently used in the toolrooms of a host of important aircraft, automobile, watchmaking and general engineering organisations for the production of profile gauges, form tools, press tools and many other highly precise aids to production.
Operators and managements in these works fully appreciate the value of the Wickman Optical Profile Grinding Machine—"The most helpful piece of equipment we've got," says one—and another, "We could not produce our type of work without it." We would like you to meet some of these users, we think they would convince you. Why not let us take you round, or send you fuller information.



CIRCULAR FORM TOOL
Grinding time 1½ hours
Accuracy ... ·001"



DIE GAUGE for Stator Blade
Gauge Steel
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Accuracy ... ·0003"



FLAT FORM TOOL
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From unshaped tip
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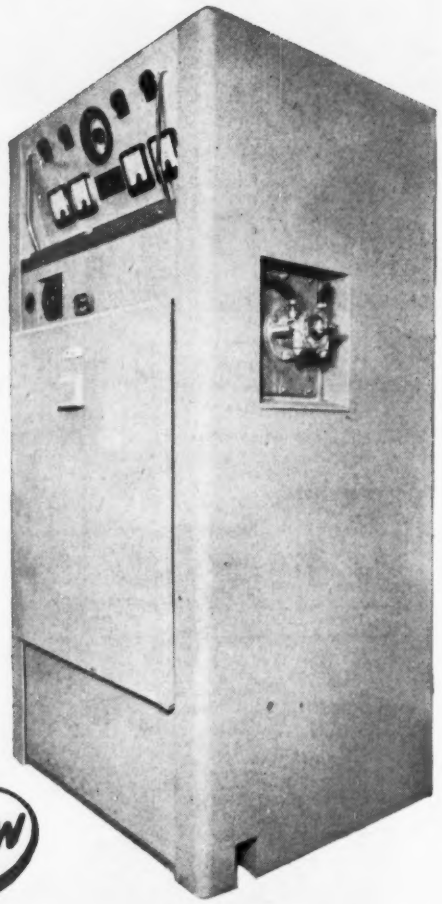
Faster

SOLDERING

BRAZING

HARDENING

ANNEALING

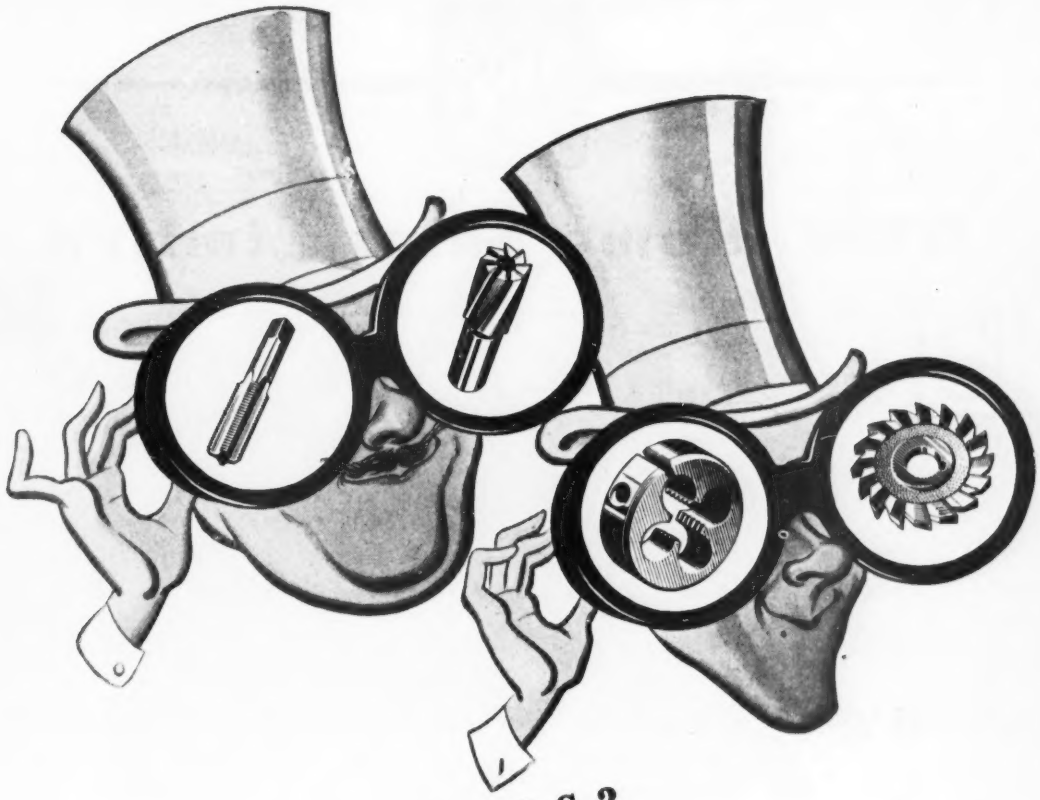


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Specialised handling gear for
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"It's a favourite's race — who'd be a bookmaker!"

"No takers! The only 'cert' today is our good friends the twist drill specialists."

"Sshh! Don't remind me — I've come for a day's sport."

"So have I — but for M & C Service we'd be suffering a few headaches."

"True — didn't realise their 'service' ran to taps,
reamers, milling cutters and all small tools!"

" Odds on — every time! They're off!!!"



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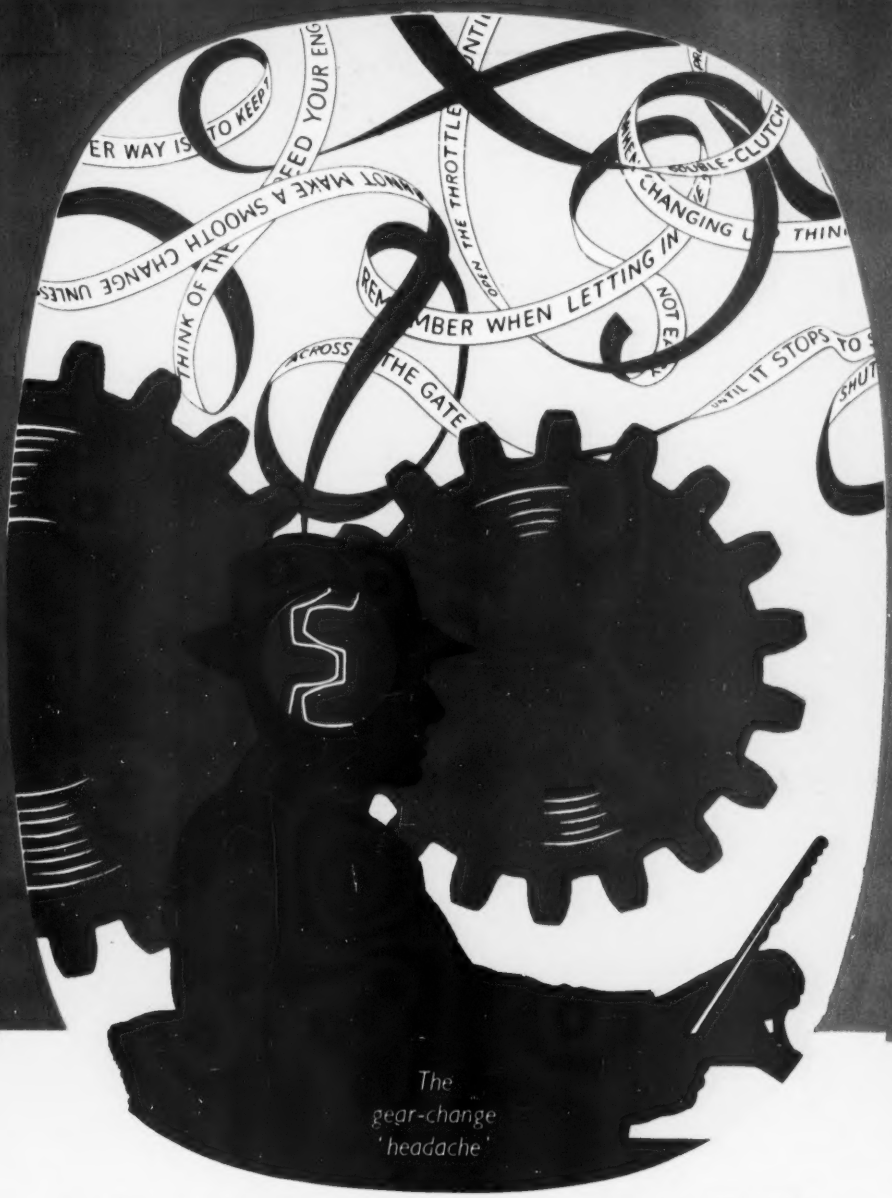
Blackplate

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The gear-change 'headache'

EXIT — BOTTLENECK TO PROSPERITY

Increasing activity of the motor industry must depend ultimately upon the ease with which the new motorist can acquire the necessary skill to drive safely. To eliminate what is a 'headache' to many, and to give a perfectly synchronized change—with or without a clutch pedal—is the ideal successfully attained by 'MANUMATIC'.

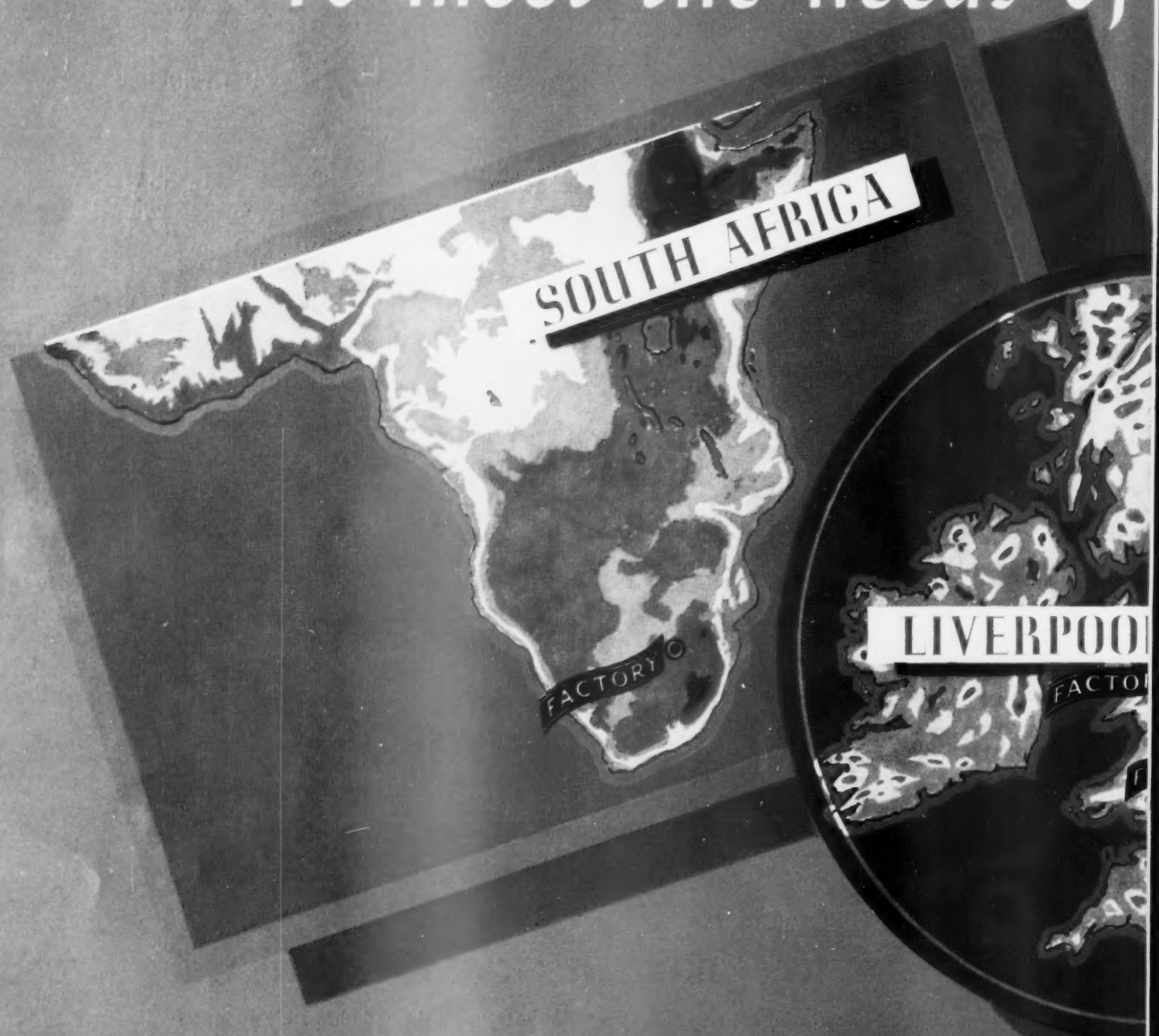
Your layman friends may like to have our 'Manumatic' pamphlet.

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MOLYBDENUM HIGH SPEED STEELS

—now rapidly approaching the leading position in world production



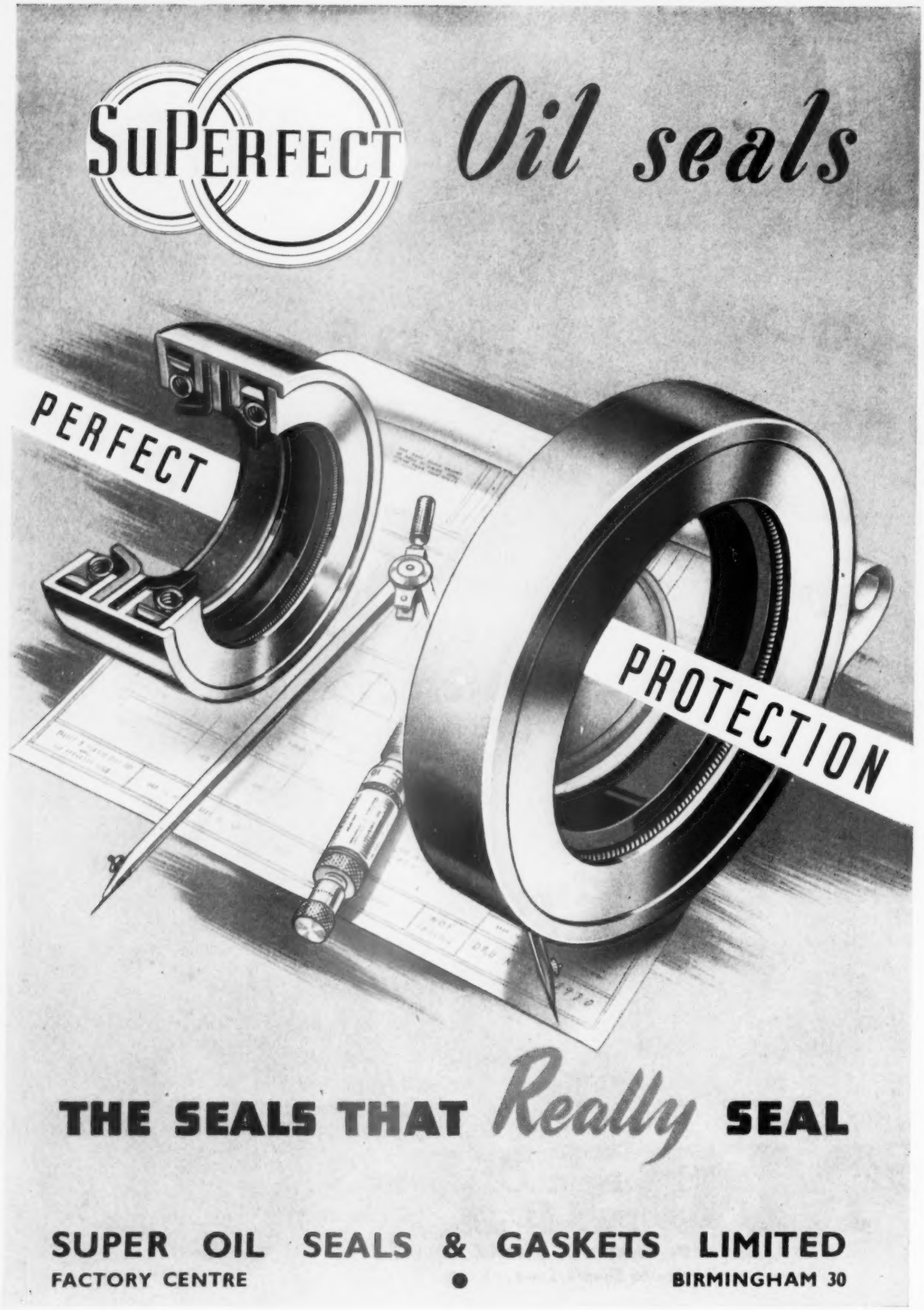
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MOLY

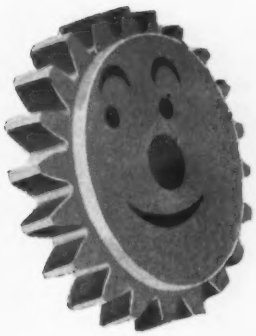
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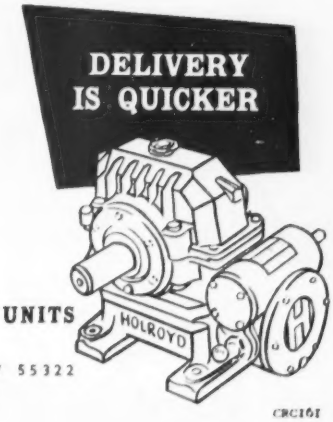


heard about Holroyd's?

They're all grinning like Cheshire cats, throwing their caps in the air and patting themselves on the back. They couldn't be more pleased if Lancashire won the Roses match.

Well, what are they up to now?

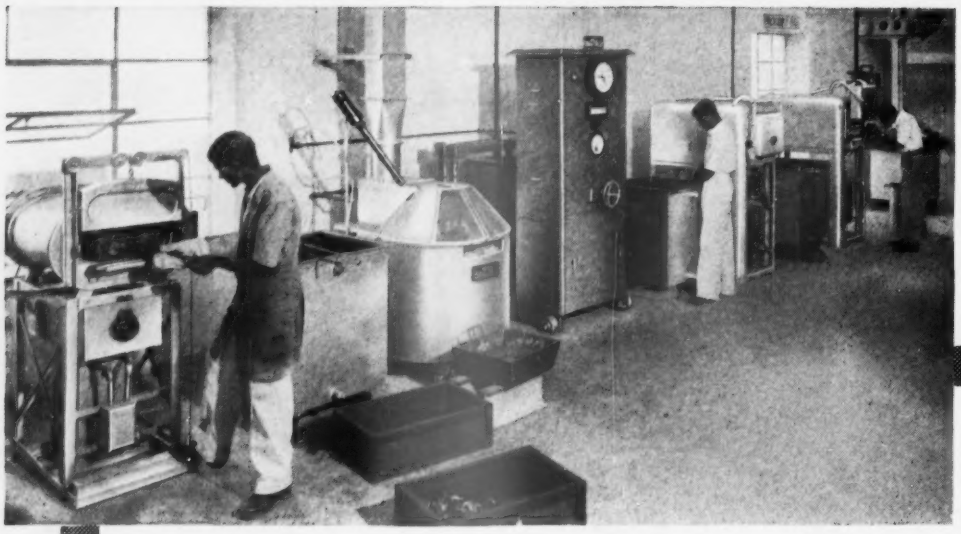
For quite a long time, they've had to form their worm reduction unit customers into a queue. Holroyd's didn't like queues any more than their customers did. So they set to work, put up a new building, initiated new methods, improved old ones, booked this space, wrote these words to tell you that . . .



Holroyd WORM GEARS AND WORM REDUCTION UNITS

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The heat-treatment shop at a large Indian industrial works, shown above, is equipped with Wild-Barfield furnaces including a Horizontal Oval Muffle, an Electrode Salt Bath and Switchgear, two Horizontal General Purpose Furnaces, an "ESB Minor" Salt Bath, Toolroom Tempering Furnace and a Horizontal Rectangular Muffle. The reliable and robust construction of these furnaces and their high degree of precision in temperature control are typical of the whole range of Wild-Barfield furnaces, from the smallest of light-duty types to full-scale production plants. Details will gladly be supplied on request.

ELECTRIC WILD BARFIELD FURNACES

WILD-BARFIELD

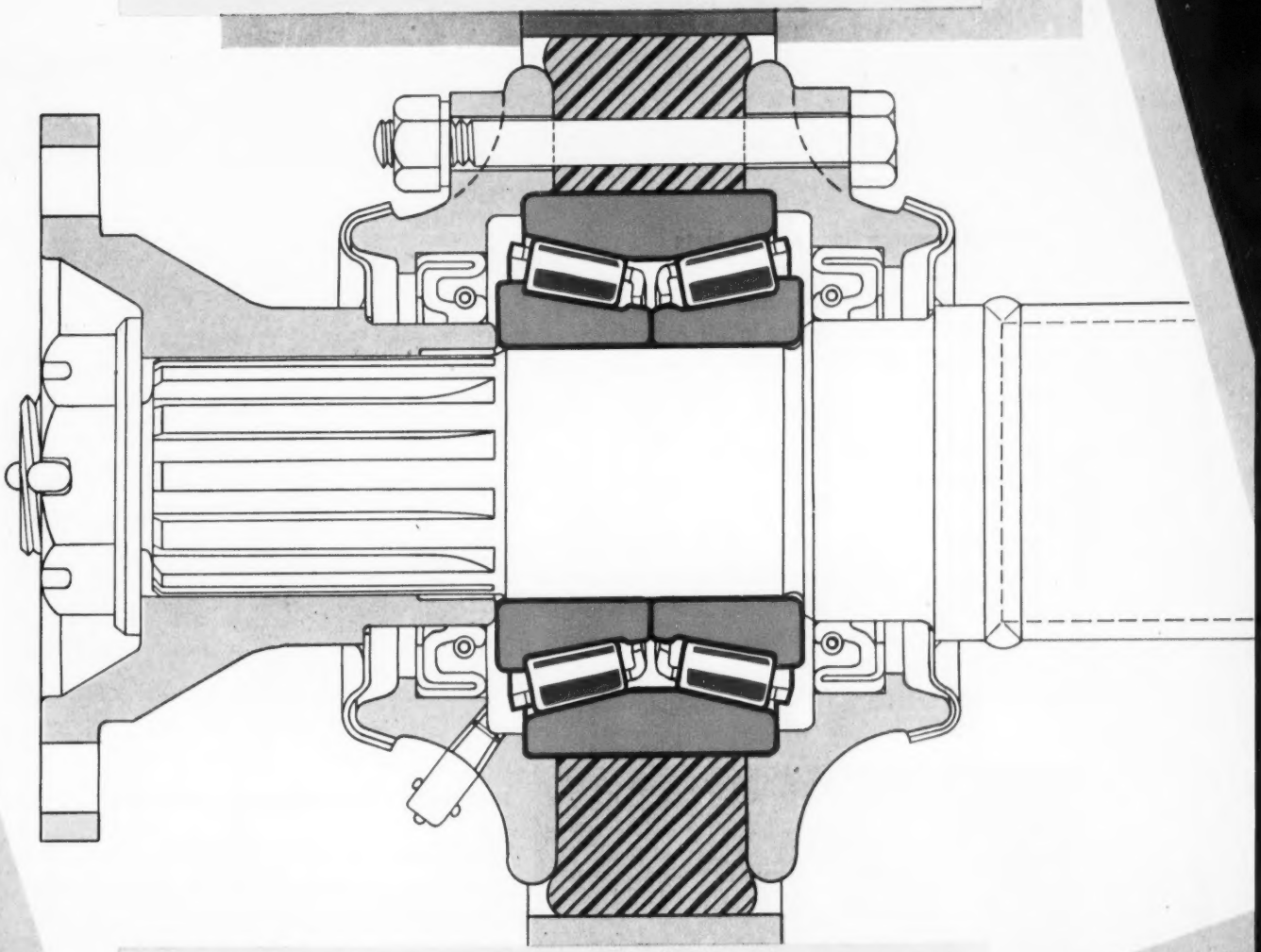
ELECTRIC FURNACES

for all heat-treatment purposes

WILD-BARFIELD ELECTRIC FURNACES LTD.,
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PROPELLER SHAFT SUPPORT

The sectional drawing shows a useful application of Timken tapered-roller bearings in commercial vehicles.



The propeller shaft support bearing is carried in a synthetic rubber block, which, deformed by tightening the end covers, is caused to grip the bearing cup and the frame bracket, giving a self-aligning support which also offers a certain amount of cushioning to bearing reaction impulses.

BRITISH TIMKEN LTD., DUSTON, NORTHAMPTON; AND BIRMINGHAM

Telephone: Northampton 4921/8 Telegrams: Britimken Phone Northampton

SUBSIDIARY COMPANIES: Fischer Bearings Company Ltd., Wolverhampton. Timken-Fischer Stockists Ltd., Birmingham

MADE IN ENGLAND

REGISTERED TRADE MARK: TIMKEN

TIMKEN

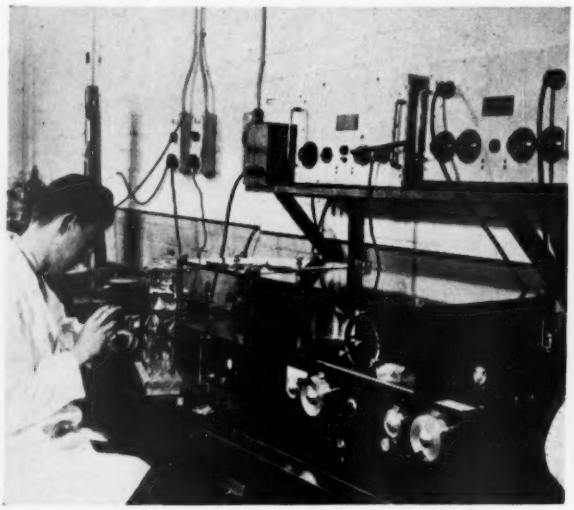
tapered-roller bearings

RESEARCH AND

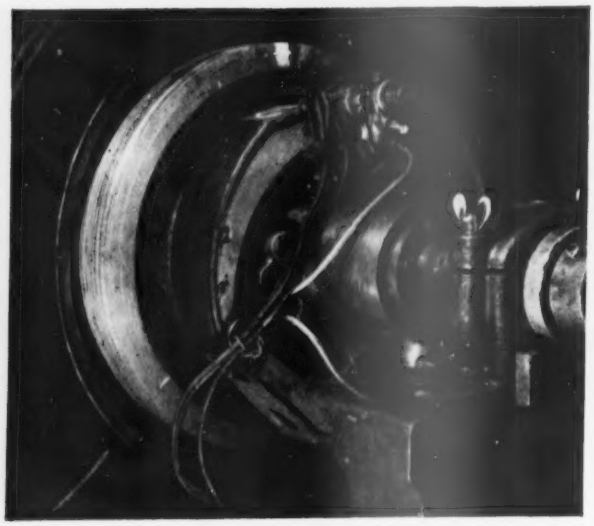
FERODO *Anti-Fade* BRAKE LININGS

Original Research finds out the facts

The choice of basic materials for brake lining manufacture depends on the fullest understanding of their properties. Often the facts are incomplete and, for this reason, Ferodo have undertaken original research into the fibre structure of asbestos, and the bonding and heat resisting properties of the resins which bond it to the other ingredients. On these and other subjects, such as interfacial phenomena and other variables which affect friction, the work of Ferodo's chemical research laboratory is not only increasing scientific knowledge generally, but ensuring the accurate composition of every type of Ferodo Lining.



Examination of raw materials by infra red spectroscopy.



Installation of a Lead Sulphide Cell Radiation Detector inside a Brake Assembly.

The Physical Test Laboratory checks Results

The Ferodo Physical Test Laboratory constitutes a completely new approach to brake lining evaluation. Ingenious machines, specially designed, subject sample linings to the equivalent of years of gruelling wear. This enables important tests to be made—under conditions far harsher than would ever actually be experienced—of friction, life, performance under high temperatures, and drum wear. (A lead sulphide cell radiation detector pyrometer tests brake linings for fade up to temperatures of 800°C.)

TESTING GIVES

EXTRA EFFICIENCY



The Ferodo Test Car Fleet.

The FERODO Car Fleet makes conclusive tests

Ferodo maintain a large fleet of cars for the final, practical testing of Ferodo Linings on the road and on the M.I.R.A. track. Sample linings are tested under every type of road condition and meticulous records made for checking with the results of laboratory tests.

Ferodo leave nothing to chance at any stage of brake lining manufacture. Their facilities for research and testing are the finest in the world. They are freely at the disposal of the motor industry at all times.

FERODO

BRAKE AND CLUTCH LININGS

FERODO LIMITED · CHAPEL-EN-LE-FRITH

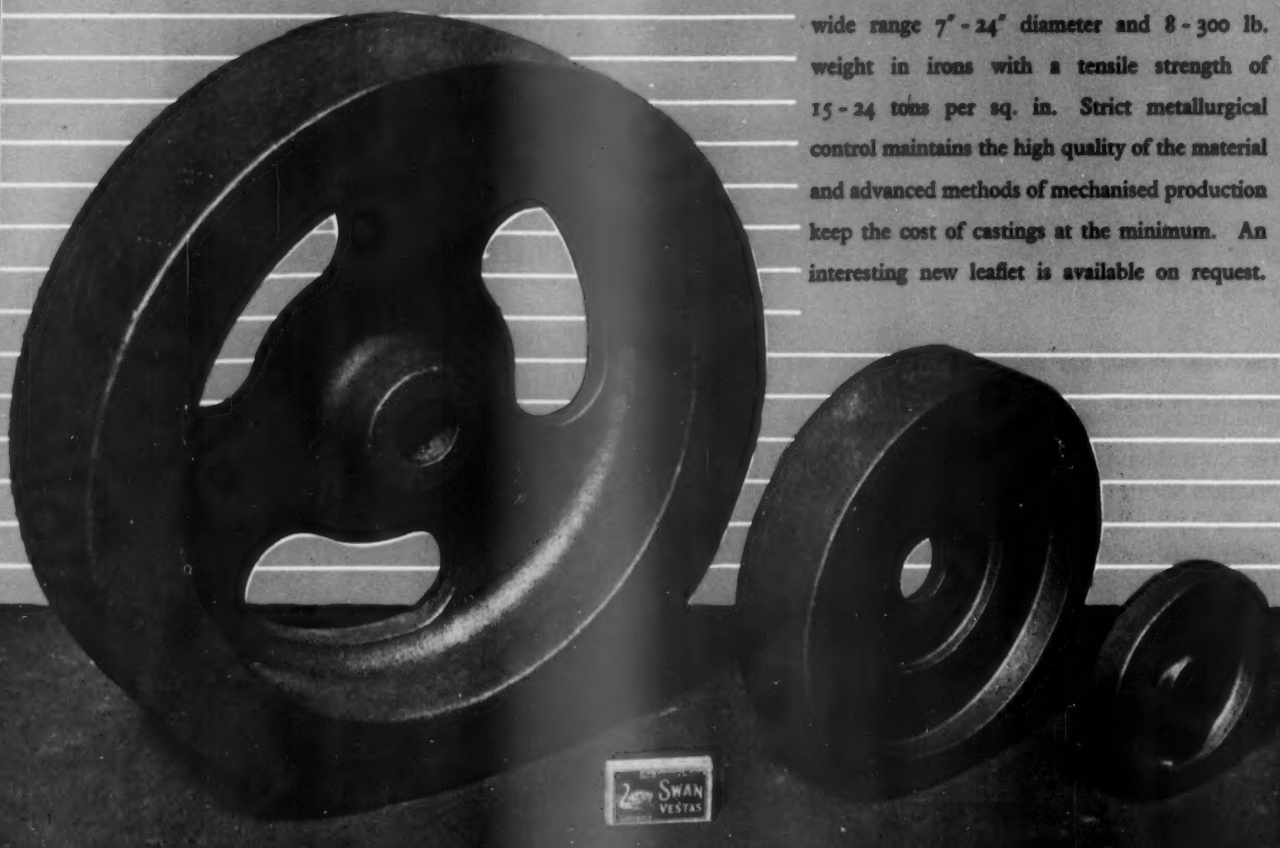
A Member of the Turner & Newall Organisation

FLYWHEELS
IN CAST IRON

by

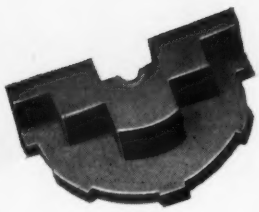
DARCAST

Exhaustive tests at high speeds and production and use over a long period have proved the suitability of Darcast Flywheels in high duty cast iron for petrol and diesel engines and for compressors. Long specialised experience ensures homogeneity in the castings which is necessary to obtain uniform density with perfect balance, while the machining faces are free from hot-crazing and suitable for friction clutch operation. Our current production covers a wide range 7" - 24" diameter and 8 - 300 lb. weight in irons with a tensile strength of 15 - 24 tons per sq. in. Strict metallurgical control maintains the high quality of the material and advanced methods of mechanised production keep the cost of castings at the minimum. An interesting new leaflet is available on request.



DARTMOUTH AUTO CASTINGS LIMITED

SMETHWICK 40 BIRMINGHAM

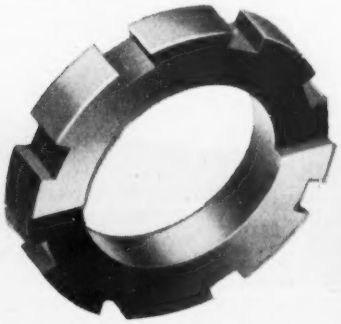




Machine and structural parts... without machining

Many of the smaller machine parts are expensive or difficult to make by conventional methods because of the machining involved. With the Powdiron process, metal powders are compressed into extremely accurate dies to produce intricate designs having such a smooth finish that further machining is eliminated. Naturally the shapes must be such that they can be produced in this way, but it is quite often possible to adjust a design so that it can be, without any loss of operational efficiency. We would like you to know more about the advantages of Powdiron. May we send you a copy of our folder "Sintered Components by Powder Metallurgy"?



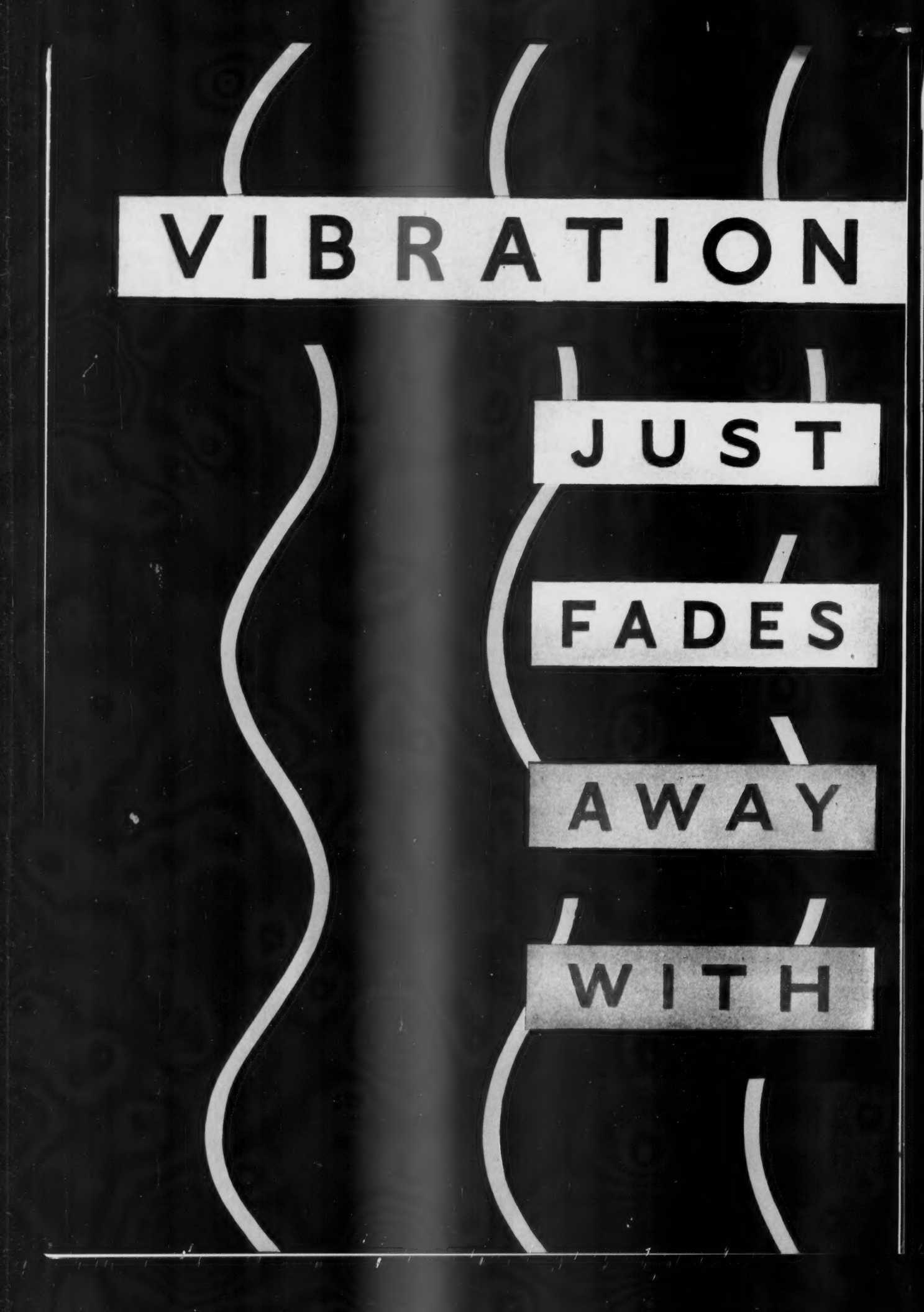



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As the world's biggest manufacturers of axles for trucks, buses and trailers, Timken have unrivalled experience, from which has evolved their present design of unprecedented strength. These axles, available with three alternative final drives, have been intensively developed to stand up to the stress of commercial vehicle operation.

THE HOUSING: The axle housing incorporates many valuable features: the rectangular section is forged with dense metal at the small-radius corners, increasing its beam-strength and affording a wide spring seat: the upset-forged axle-ends, butt-welded to the housing, have integrally-forged brake flanges. At the centre the front flange is heavily reinforced, at the rear flange a heavy cover is welded on, and an additional reinforcing plate resists spread of carrier parts. Rigidity and strength are greater, yet weight is less, capacity for capacity, than in any other axles.

THE HALF-SHAFTS: These, forged with the grain structure of the steel conforming to the profile of the flange, are specially heat-treated, with the surface hardness graduated to a softer centre core. To increase fatigue resistance, the heat-treated shafts are shot-peened.

GUARANTEES — *Housings:* At any time during the life of the vehicle in which they are first used after manufacture, any housing that breaks under fair usage (see pamphlet for details) will be replaced free for the manufacturer of the vehicle.

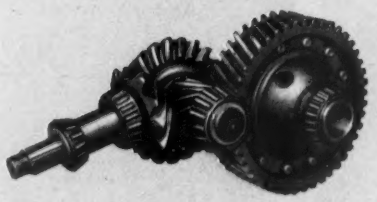
Shafts: Are guaranteed against breakage for 100,000 miles or for three years, whichever occurs first. (See pamphlet.)

Exclusive European distributors for The Timken-Detroit Axle Division, Rockwell Spring and Axle Company, Detroit, Michigan, U.S.A.

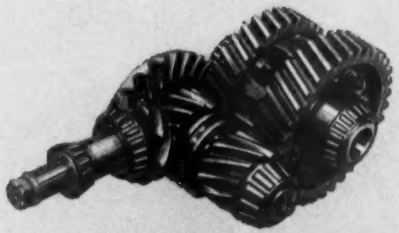
AUTOMOTIVE PRODUCTS COMPANY LIMITED
BROCK HOUSE, LANGHAM STREET, LONDON, W.1, ENGLAND



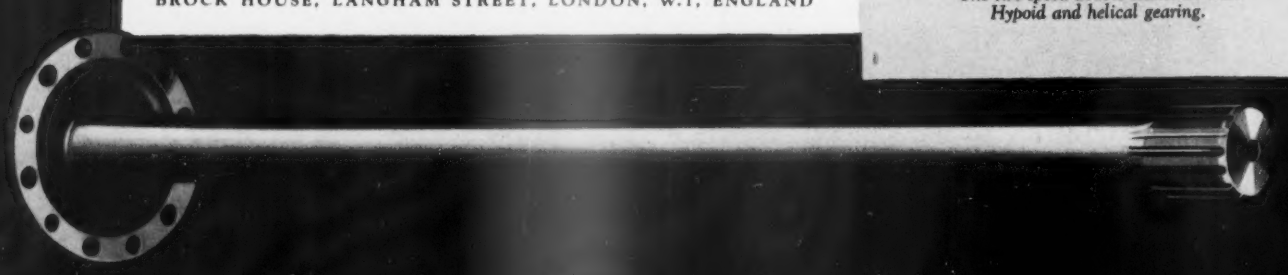
The Hypoid single-reduction final drive has many exclusive features of design and construction.



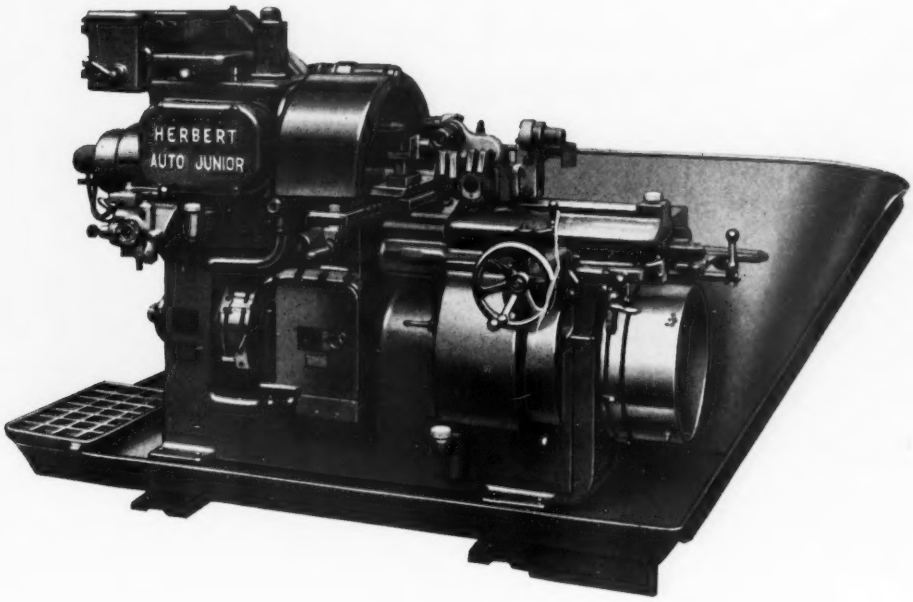
Hypoid gearing is used for the first reduction in double-reduction final drive.



The two-speed double-reduction with Hypoid and helical gearing.



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FAST • ACCURATE • EASY TO SET

AN automatic chucking machine for the rapid machining of small parts of cast-iron, steel or non-ferrous metals.

One operator can attend to four or more machines.

The patent self-selecting feed motion enables each operation to be done at the most suitable feed, ensuring a high rate of production.

Air or electrically-operated chucks reduce idle time to the minimum.

Capacity: Parts of disc form up to 6″ × ½″, other parts up to 4¼″ diam. × 3½″ long.

Maximum swing	8½″
Working stroke of turret	5¼″
Speed range, r.p.m.	53 - 1484

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English micrometers are equipped with screws of 40 T.P.I. and Metric with 0·5 m/m pitch.

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Double bearing support to rocker shaft.

End-location adjustable.

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Very compact box.

For fore-and-aft or transverse layout.

Trunnion or spigot mounting alternative on heavy types.

THE 'MARLES' DOUBLE-ROLLER GEAR, made in a range of sizes covering every type of chassis.

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Screw and washer assembled to form one complete, ready-to-use component, requiring one handling operation and eliminating tedious and costly assembly by hand. As soon as a Sems is dropped into position it is ready for driving. Easily handled and fast to drive. No lost or wasted washers and each screw fitted with the correct type and size of washer. Simplifies indenting and stock-keeping too. This is No. 5 in our series of advertisements and the emphasis is upon time-saving. Of course, there are again those two all-important factors that stamp everything Linread make and do. Quality and Service.
Linread
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★ The automobile industry has made a remarkable response to the country's call for increased output. In five years production has been doubled, and this in spite of material shortages, lengthening deliveries of new equipment, and plant extension restrictions. A very important contributing factor to this increased productivity has been the wider application of Wimet carbide tools for the hundred-and-one machining operations which go to make the modern motor-car.

WICKMAN *of* **COVENTRY**

Wimet

259 51



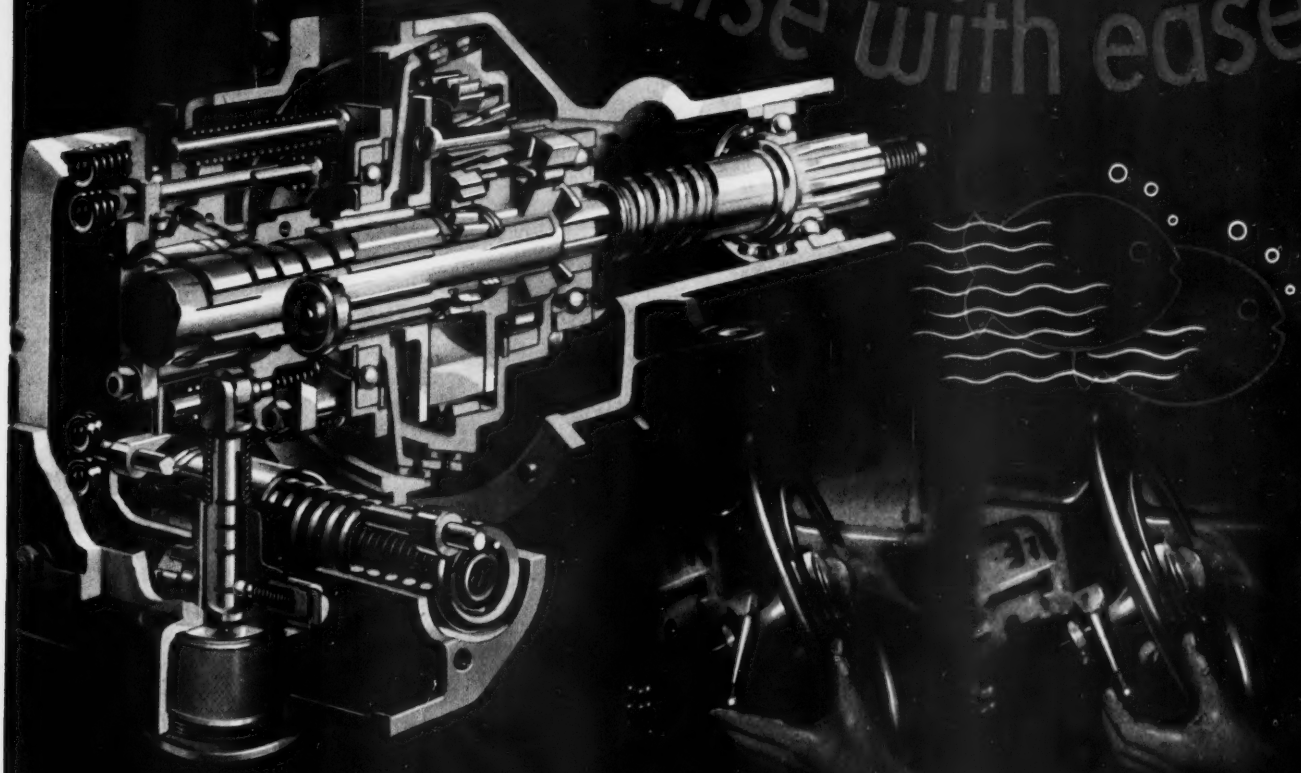
The LAYRUB PROPELLER SHAFT is widely used in the transmission systems of cars, commercial vehicles, passenger transport vehicles, tractors, diesel railcars, and many others. It provides a perfectly smooth drive owing to the absence of metal-to-metal contacts; no lubrication is required, therefore, little maintenance.

The illustrations show, Fig. 1. the Layrub Shaft installed on a Jowett 'Javelin' car, Fig. 2. and Fig. 3. typical installations used very extensively by the leading Commercial Vehicle manufacturers at home and abroad.

Write us for technical catalogue which we shall be pleased to mail you.

LAYCOCK ENGINEERING LTD. MILLHOUSES - ST. FIELD - 8 -

we cruise with ease

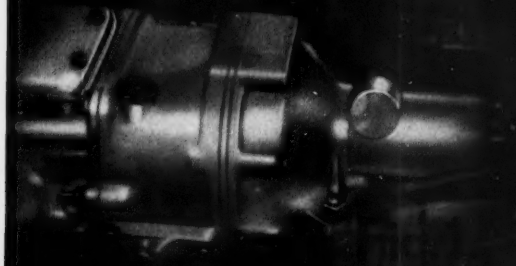


The LAYCOCK-de NORMANVILLE OVERDRIVE is a self-contained unit fitted to the rear of the gearbox (Fig. 1). It provides the so-much-desired extra high gear. (On a well-known make of car with a top gear ratio of 4.625 to 1, the overdrive raises it to 3.6 to 1.)

On this particular make of car the overdrive is engaged instantaneously by the mere finger-tip movement of the gear lever, from top to overdrive (Fig. 2 shows normal top gear position, Fig. 3 overdrive), and without movement of foot controls (Fig. 4). Full power is continuously transmitted, the operation being immediate, effortless and undetectable.

Control of this overdrive can be arranged in a variety of ways, and by co-operation with Joseph Lucas Ltd., a semi-automatic form of overdrive control has been developed. In order that the driver shall still have final control a manual switch is included in the circuit. Normally, with the manual switch not operating, at a pre-determined speed the car will change automatically into overdrive from top gear. The driver can at any speed (above cut-in speed) re-engage top gear by operating the manual switch, and this can be so arranged that his hand need not leave the steering wheel. By means of the Laycock-de Normanville Overdrive with the Lucas Automatic Overdrive Control an extra gear is added to the car, requiring no action on the part of the driver to engage it.

Technical leaflet describing the complete operation of this overdrive will be gladly mailed you on application to: Laycock Engineering Ltd., Victoria Works, Millhouses, Sheffield, 8.



The Laycock-de Normanville overdrive

LAYCOCK ENGINEERING LTD. [illegible] TRANSMISSIONS LTD.



Forging shear blades from R.T.B. special steel at the
Panteg works of Richard Thomas & Baldwins Limited.



DON'T IMAGINE (said the Managing Director) that I *like* the game. Far rather would I be among my happy employees, laughingly finding fault with their work and jollying them on to greater efforts for the honour of the Dear Old Firm. Only a stern sense of duty and the need to let a Very Important Customer beat me at something, gets me on to the golf course on this glorious autumn day. The Customer First! That is the spirit of Desoutters.

If you use small power tools; think you *might* use small power tools; have a Special Problem (provided it is to do with your Works and not your Family Affairs), get in touch at once with my faithful and hardworking staff.

As for me, I will sacrifice myself on this wretched links. Will you drive first, Sir?....

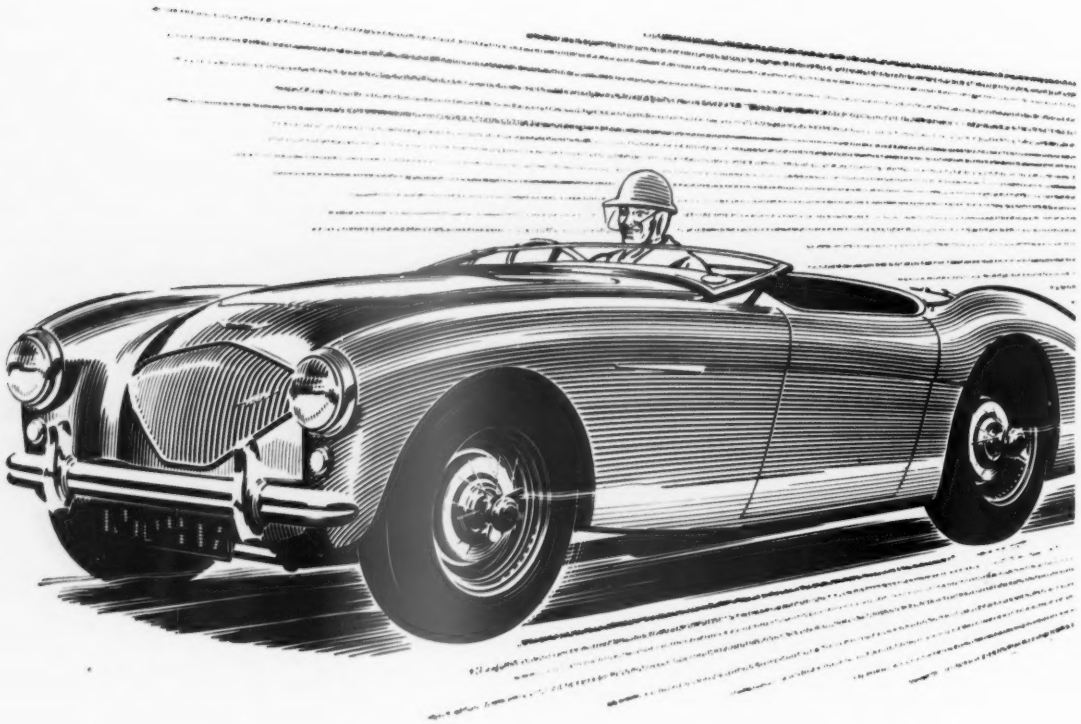
Is my old friend in the bunker, or did the old So-and-So scrimble on to the fairway?

Desoutter Tools

put power into your hands

Desoutter Bros., Ltd., The Hyde, Hendon, London, N.W.9. Telephone: Colindale 6346 (5 lines). Telegrams Despnuco, Hyde, London.

CRC 248



Helping to put the Austin-Healey *first*

The world record-breaking Austin-Healey 100 car was equipped with bodywork entirely fabricated in T. I. Aluminium Alloy, specification T. I. 111.

PUT Aluminium FIRST
AND TI IN FRONT OF IT
A TI Company

T. I. ALUMINIUM LIMITED, REDFERN ROAD, TYSELEY, BIRMINGHAM 11. Telephone: Acocks Green 3333

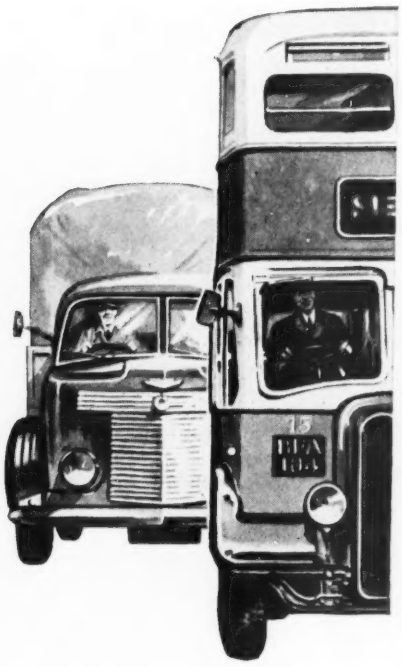
Aluminium and Aluminium Alloy Ingot, Billets, Slabs, Sheet, Strip, Plate, Tubes and Extrusions to all Commercial, A.I.D. and Lloyd's specifications

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Soon pays for itself!



* GIVES YOU 10% EXTRA SERVICE FROM EVERY VEHICLE!



The 'Syndromic' system lubricates up to 80 bearings (using 2 pumps)—at periods automatically controlled by mileage—*while your vehicles are on the road!* In this way, hold-ups for lubrication are eliminated and you get as much as 10% more service out of your fleet at no extra cost. In fact, 'Syndromic' automatic lubricators are *more* economical. They save 75% on lubrication, reduce wear on bearings, etc., and therefore cut maintenance and replacement costs to a minimum.

So you can see how 'Syndromic' lubrication soon pays for itself!

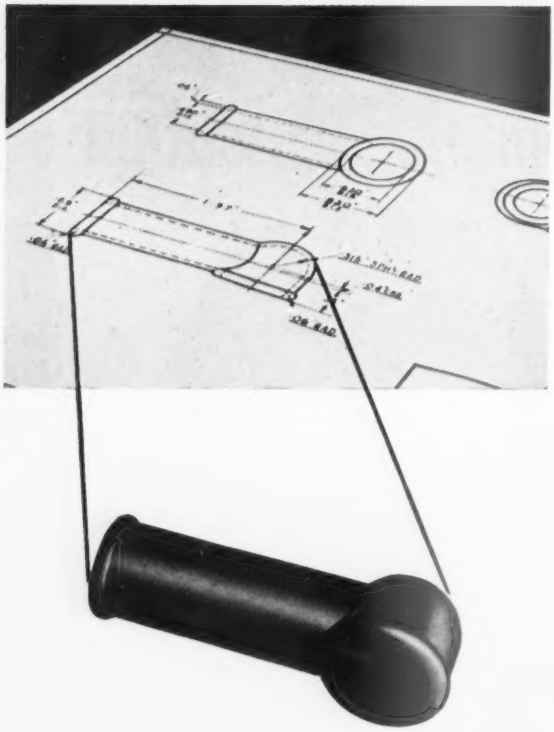
Ask for a Tecalemit technical representative to call and discuss the 'Syndromic' system with you.

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The Authority on Lubrication

PLYMOUTH, ENGLAND

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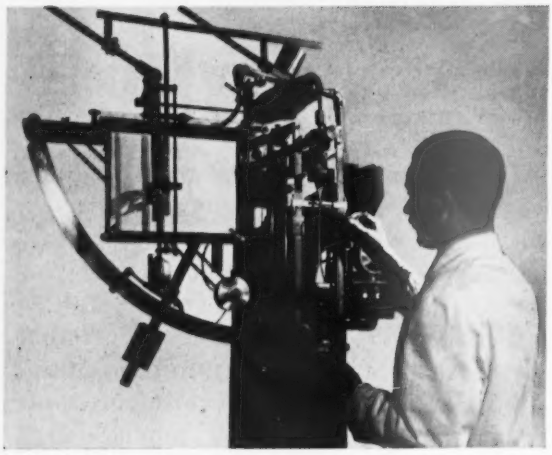


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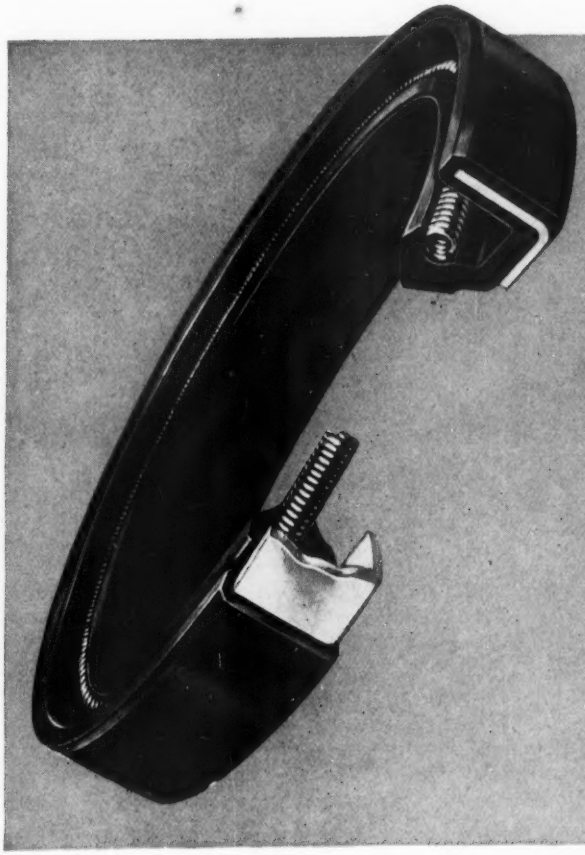


GACO
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THE GACO M.I. OIL SEAL

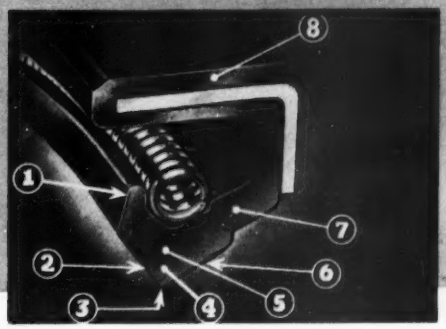
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1. Deep rim affords perfect Spring Retention.
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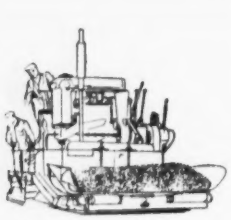
NEWCASTLE UPON TYNE, 6

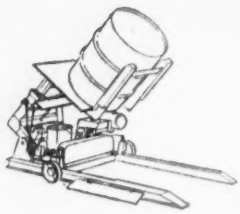
SMITHS

Hydraulics take the load off your hands

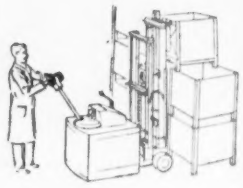
The Hydrum range of mechanical handling equipment lifts, moves or loads drums, casks, bales, carboys, sacks, crates and pallets. Smiths Hydraulics provide safe, smooth and speedy operation of the lifting gear, under perfect control, and on certain types also raise and lower the undercarriage. The use of Smiths Hydraulics to replace lifting by hand reduces labour costs, saves time and eliminates risk of accidents. Smiths Hydraulics are also used on private, passenger and commercial vehicles, garage equipment, contractors' plant, agricultural machinery, etc., etc.

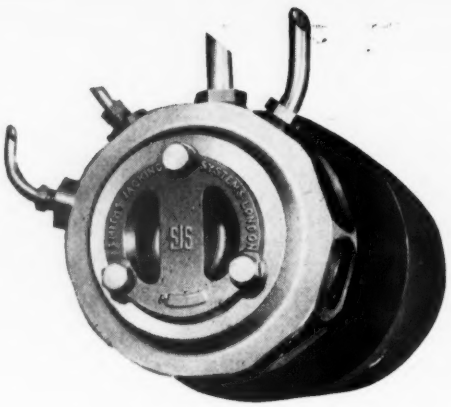














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JACKALL WORKS, EDGWARE ROAD, LONDON, N.W.2. *Telephone :* **GLADSTONE 6671-4**

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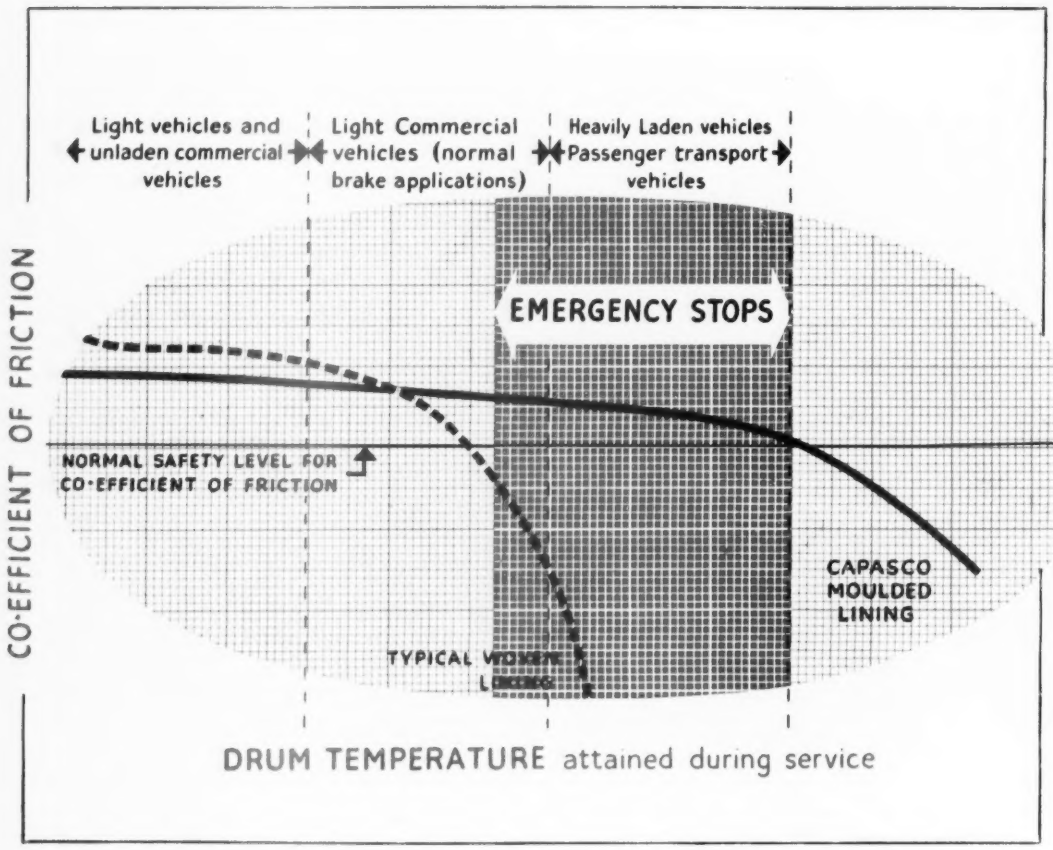
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FIRTH BROWN TOOLS LTD.

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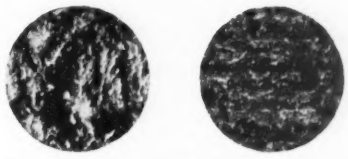
MOULDED BRAKE LININGS

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CAPASCO
moulded linings
for sustained resistance to fade

Another good reason why every CAPASCO Lining is Moulded

This graph broadly illustrates the fundamental difference in performance between moulded and woven friction materials. It can be seen that a moulded lining offers a greater margin of safety in the higher temperature range. CAPASCO is most reliable when reliability is needed most. In addition to fade resistance, CAPASCO has these other special features—Dimensional Stability—High Mechanical and Impact Strength—Rapid 'Wet' Recovery—Uniform Wear to 'Wafer' Thickness—Non-Abrasive to Brake Drums—Ease of Cleaning when Woven Linings would have to be discarded



These micro-photographs of a Woven Lining and of a CAPASCO Moulded Lining show the very striking difference in texture. It is this homogeneous structure of a Moulded Lining which is basically responsible for the excellent overall characteristics.

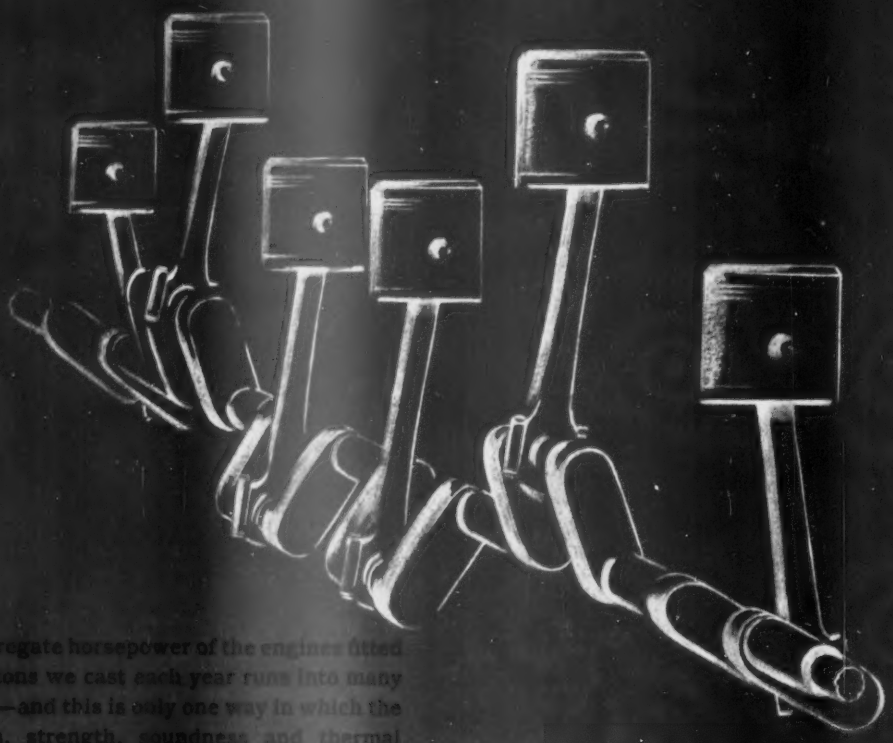
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We shall be glad to give, without obligation, specific advice on any application of Noral alloys.

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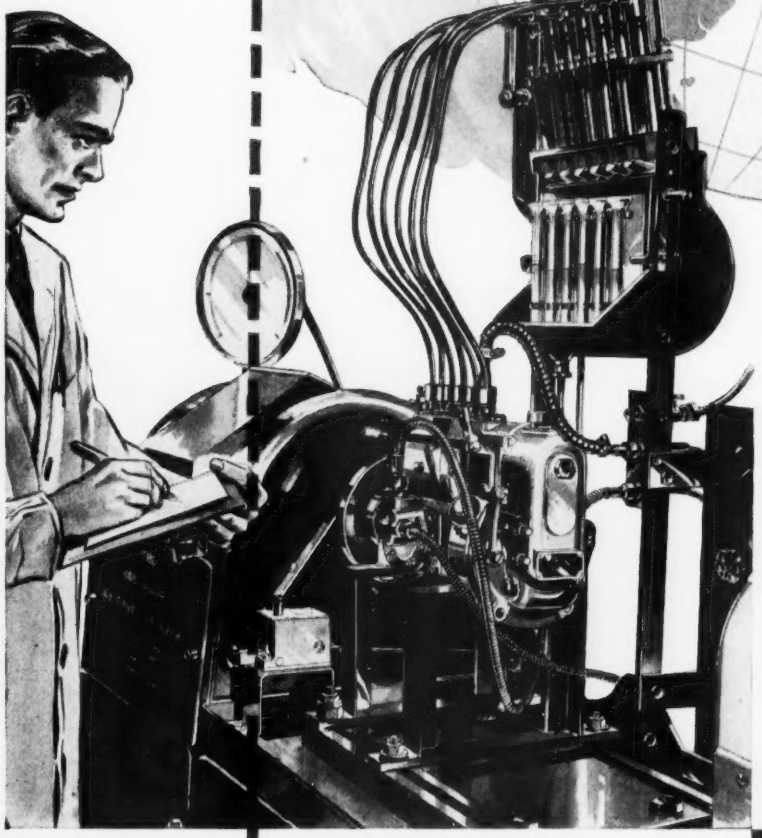
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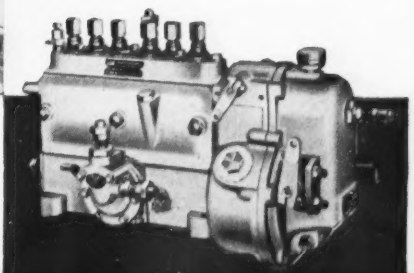
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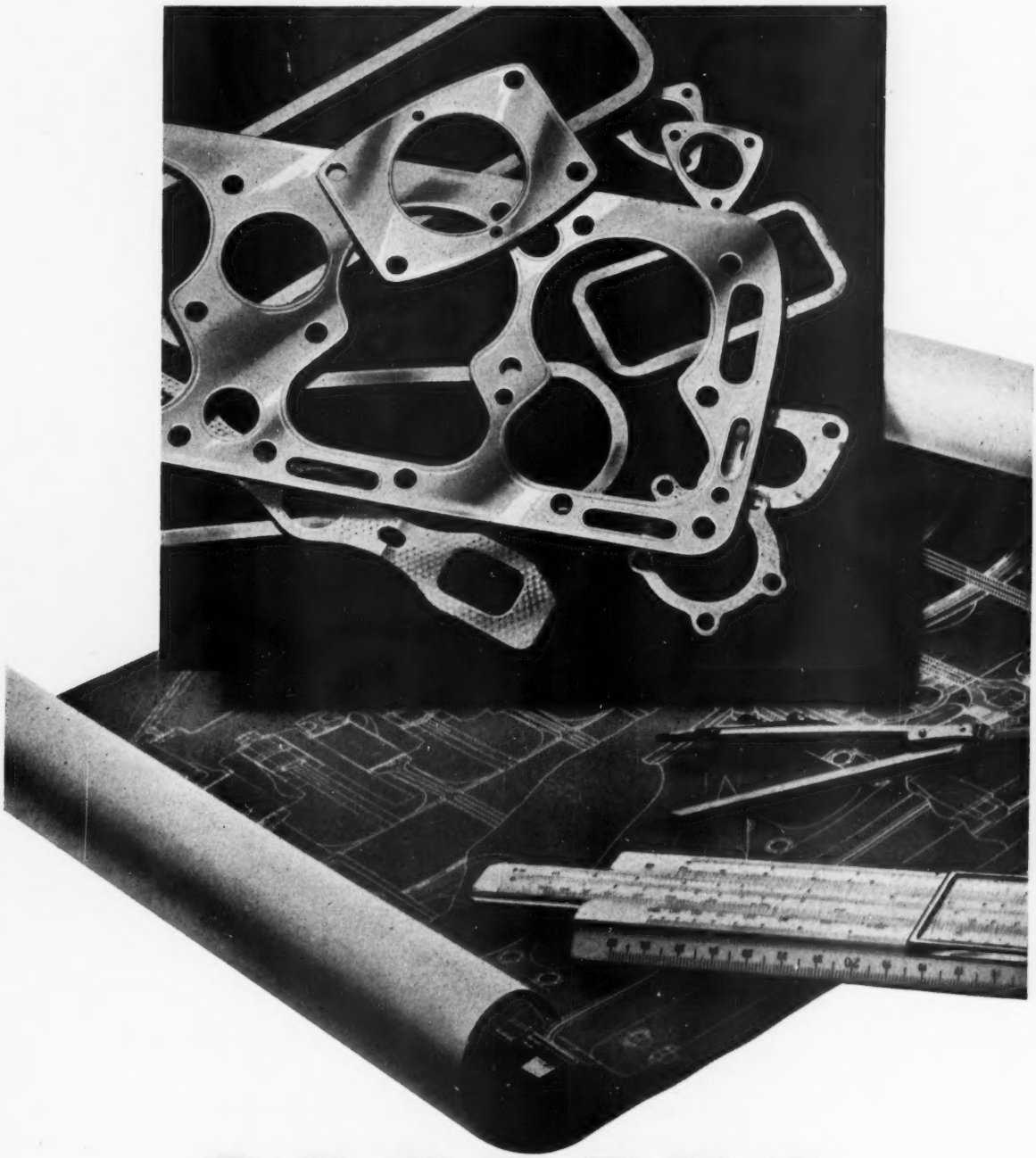
In association with

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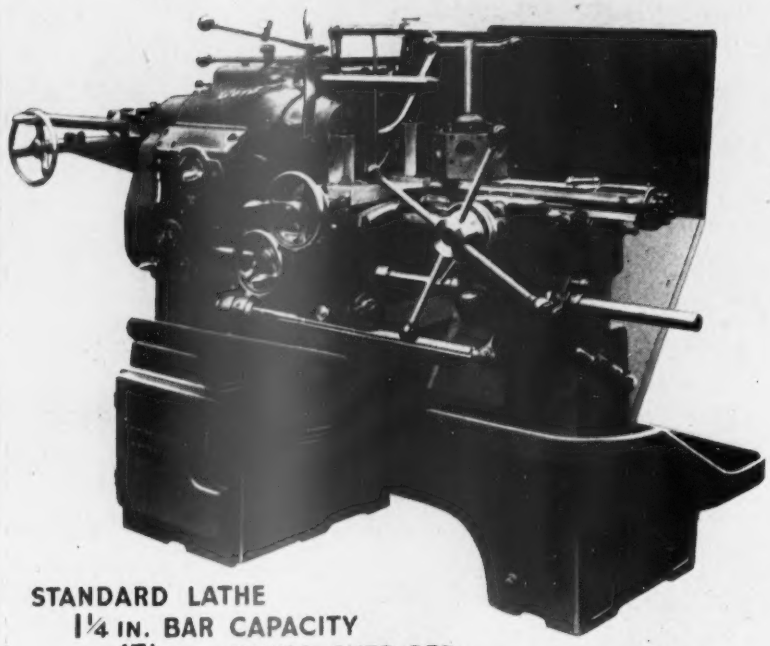
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For Maximum Production

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STANDARD LATHE
1¼ IN. BAR CAPACITY
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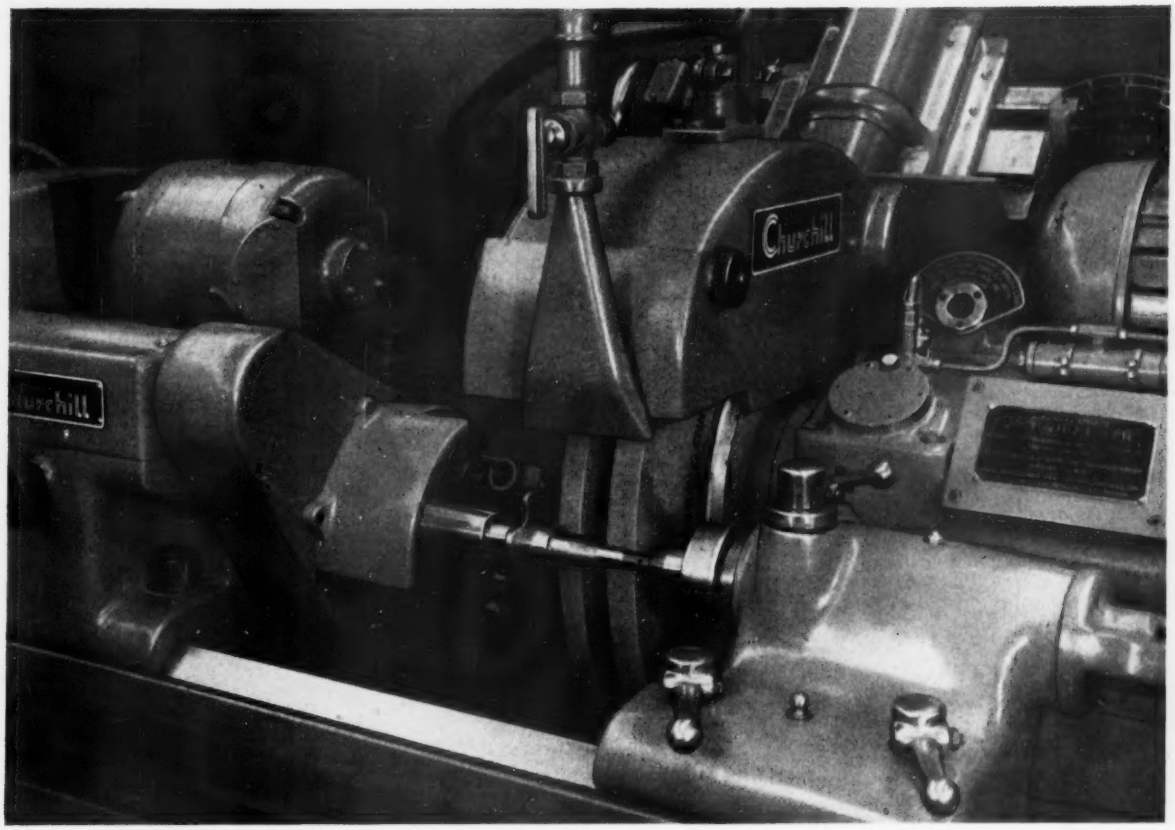
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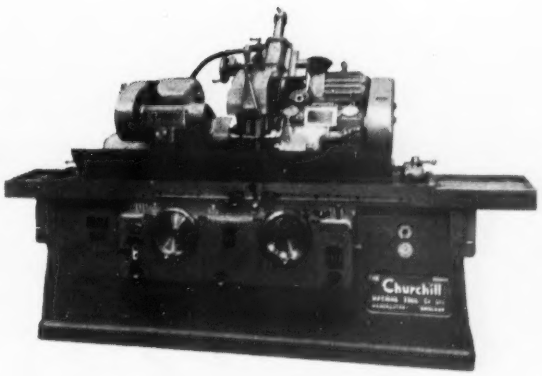
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Churchill

THE CHURCHILL Model 'BW' 10" swing Plain Grinding Machine has a reputation for accuracy and high output. The machine shown here is equipped with twin grinding wheels for grinding two diameters simultaneously. The wheel forming device is mounted permanently on the back of the wheelhead and enables the wheels to be trued in correct relationship to the finished work diameters.

The 'BW' Machine can be supplied as a non-automatic or fully automatic Plain Grinder.



THE CHURCHILL MACHINE TOOL CO. LTD., BROADHEATH, nr. MANCHESTER

Export Sales Organisation: Associated British Machine Tool Makers Ltd., London. Branches and Agents.

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Unique



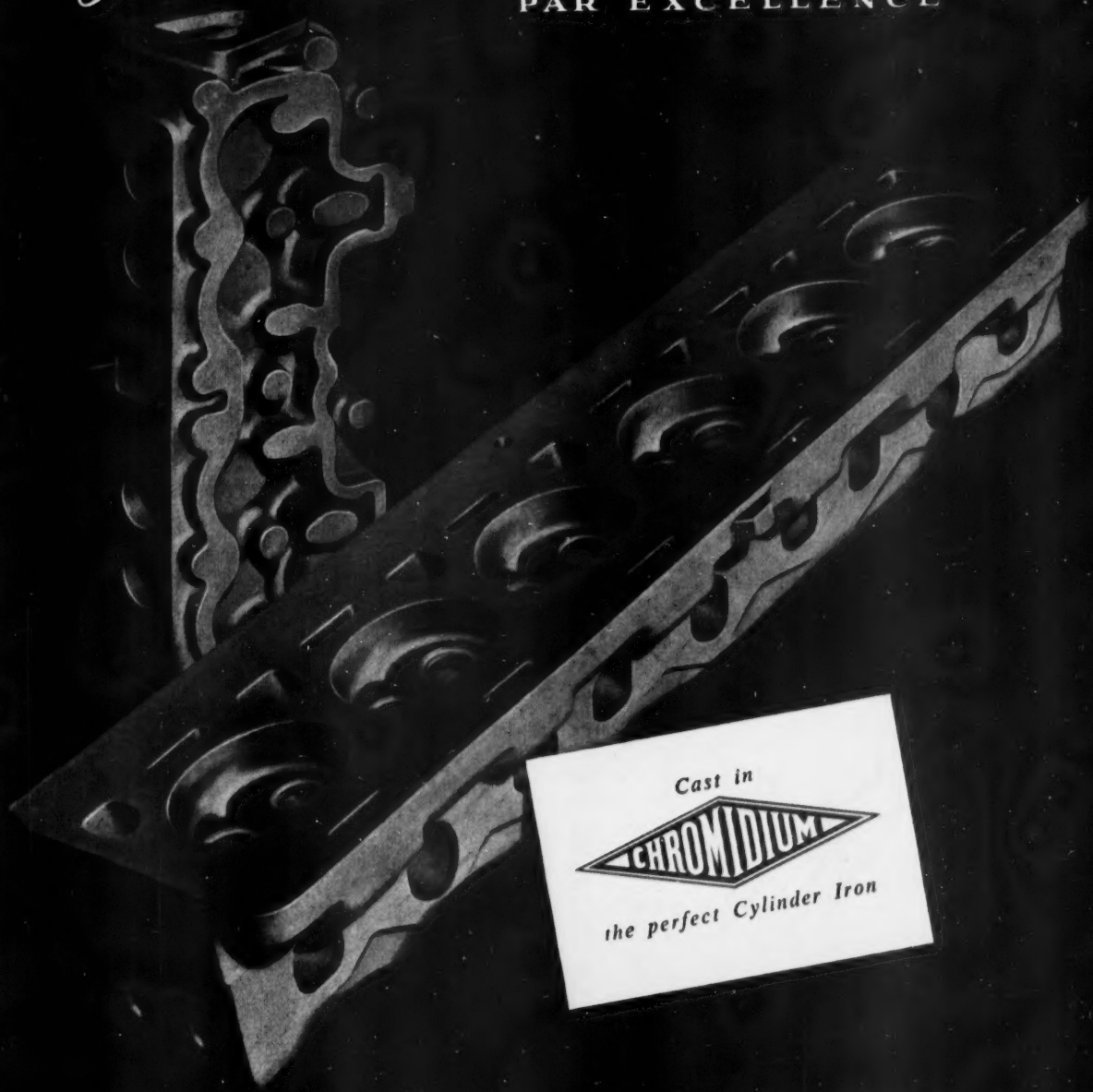
"Newallastic" bolts and studs have qualities which are absolutely unique. They have been tested by every known device, and have been proved to be stronger and more resistant to fatigue than bolts or studs made by the usual method.

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Cast in

CHROMIDIUM

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MIDCYL

THE MIDLAND MOTOR CYLINDER CO. LTD., SMETHWICK, STAFFS.



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Bahamas
Barbados
Bermuda
Brazil
British Columbia
British Guiana
British Honduras
Chile
Colombia
Canada

Belgium & Luxembourg
Canary Islands
Cyprus
Czechoslovakia
Denmark
Eire
Finland

Aden & Yemen
Burma
Ceylon
Hong Kong
India
Indonesia
Iran (Persia)

Australia
New South Wales
Queensland
South Australia

Azores
Belgian Congo
Egypt
Eritrea
Ethiopia & Somaliland
French Morocco

Gambia
Gold Coast
Costa Rica
Cuba
Curacao
Dominican Republic
Dutch Guiana
Ecuador
Guatemala
Jamaica
Mexico
Nicaragua

France & Monaco
Germany
Gibraltar
Greece
Holland
Yugoslavia
Iceland

Japan
Iraq
Lebanon
Malaya
Oman
Parkistan
Persian Gulf

Tasmania
Victoria
Western Australia
New Zealand

Kenya
Mauritius
Mozambique
Nigeria
Nyasaland
Rhodesia (Southern)

Sierra Leone
Sudan
Panama
Paraguay
Peru
San Salvador
Trinidad & Tobago
United States of America
Uruguay
Venezuela

Italy
Malta
Norway
Portugal
Spain
Sweden
Switzerland

Israel
Saudi Arabia
Syria
Thailand (Siam)
Turkey

Fiji Islands
New Guinea

Tanganyika
Tangier
Togoland
Tripolitania
Uganda
Union of South Africa

right round the World there's . . .

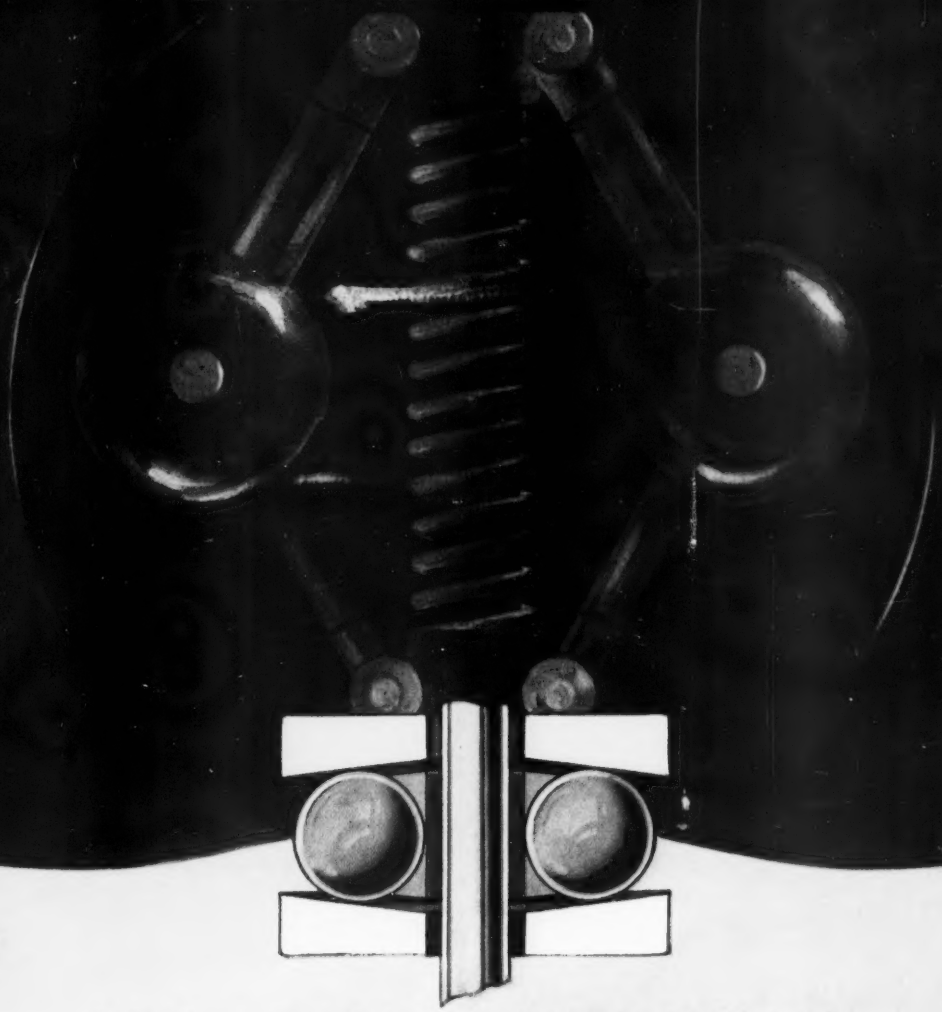
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THE BEST BRAKES IN THE WORLD

service—*Way Out Ahead*→

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Iso-Speedic governors embody flybobs which consist of hardened steel balls rolling on ground tracks, eliminating all static friction, and resulting in a high degree of accuracy.

They are used on diesel engines and petrol engines, and are available for other speed control applications.

Iso-Speedic governors can be supplied which give control within 0.3% and are used on generators for radar and television. Other Iso-Speedic governors are available where a lower degree of accuracy is sufficient.

The services of our engineers are at your disposal.

Iso-Speedic

THE ISO-SPEEDIC COMPANY LTD., COVENTRY



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the metal of the age

and the automobile industry . . .

There is no material more suitable for motor vehicle fittings than stainless steel. Its hard-wearing surfaces can neither chip nor peel off, for the metal is solidly stainless throughout.

The gleaming finish of these parts requires no polishing and is maintained merely by the use of soap and water.

The increasing use of stainless steel today in the automobile industry is proof of these qualities.

The Morris Oxford radiator grille is manufactured entirely from "Silver Fox 17" Stainless Steel and was photographed in natural colour by courtesy of Morris Motors Limited, Oxford.

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SAMUEL FOX & COMPANY LIMITED

Associated with The United Steel Companies Limited

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MAXIMUM ENGINE PERFORMANCE



CLEVECOL SPECIAL is blended to produce the highest engine performance—greater power, more mileage, faster and smoother acceleration, and a lot more pleasure in driving! Clevecol Special is far superior to any petrol previously marketed.

The Super quality Petrol distributed by

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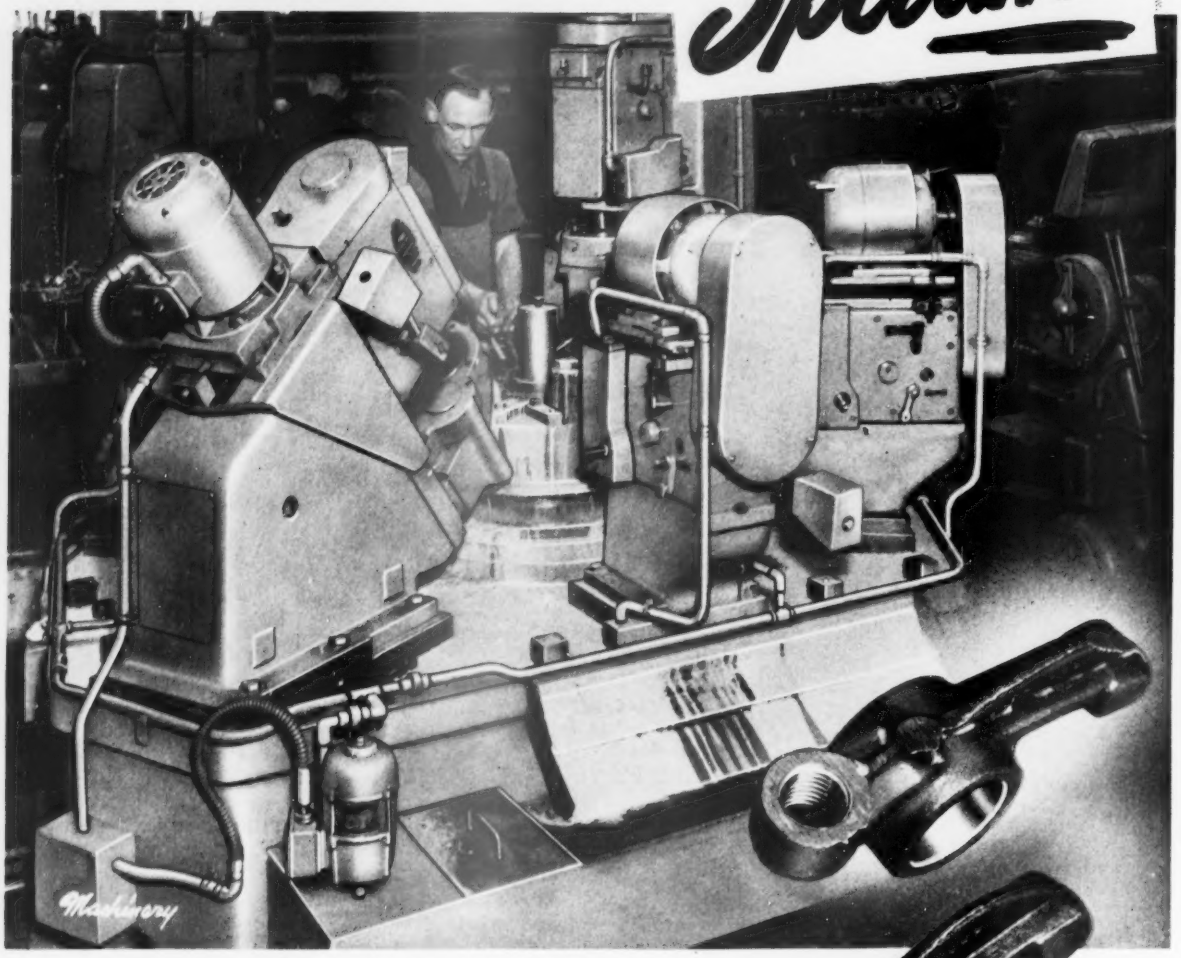
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is a most excellent blend for smooth running and extra miles per gallon.

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This 6-station machine for milling, drilling, countersinking and tapping valve rockers, is typical of hundreds of *ARCHDALE* specials supplied to the automobile industry.

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Illustration by courtesy of Siemens Brothers & Co. Ltd.

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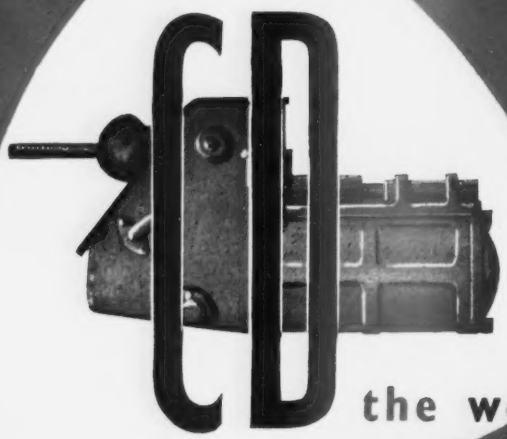
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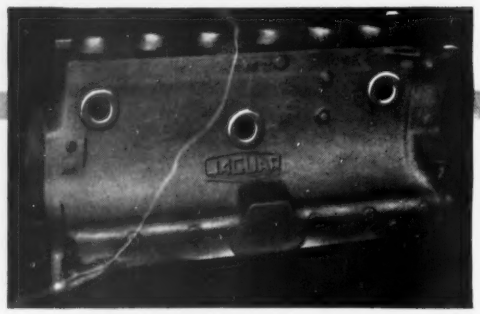
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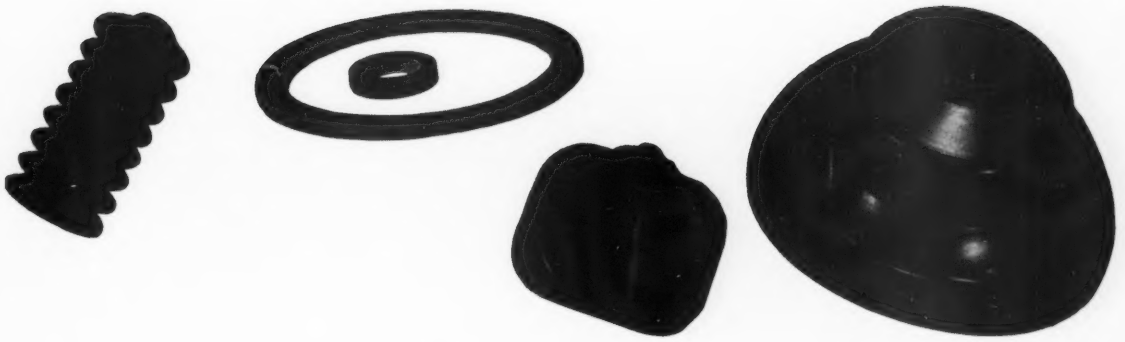
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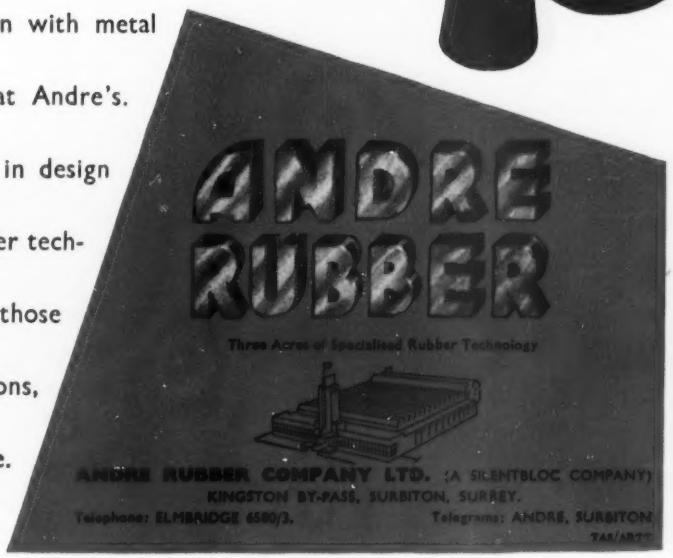
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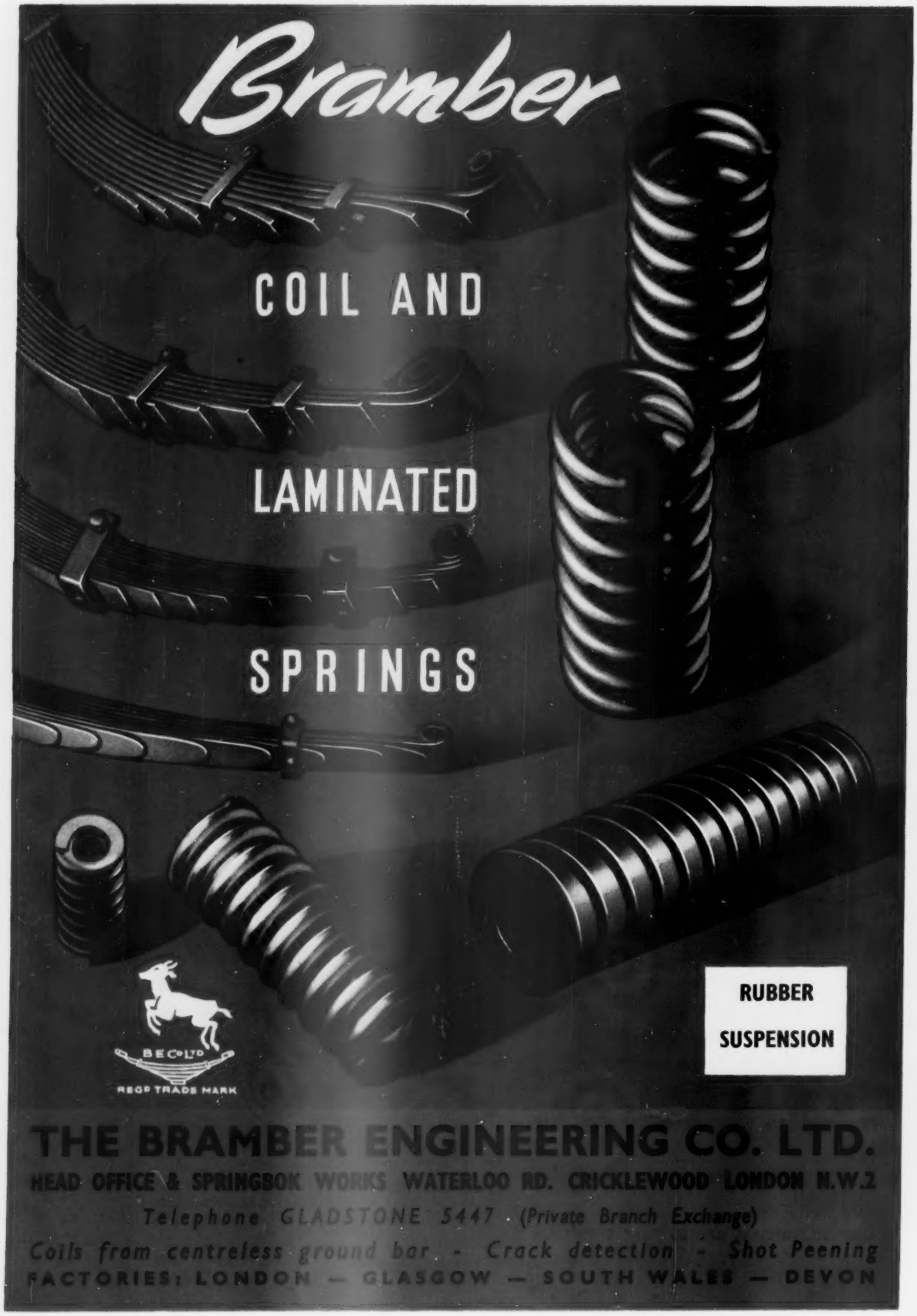
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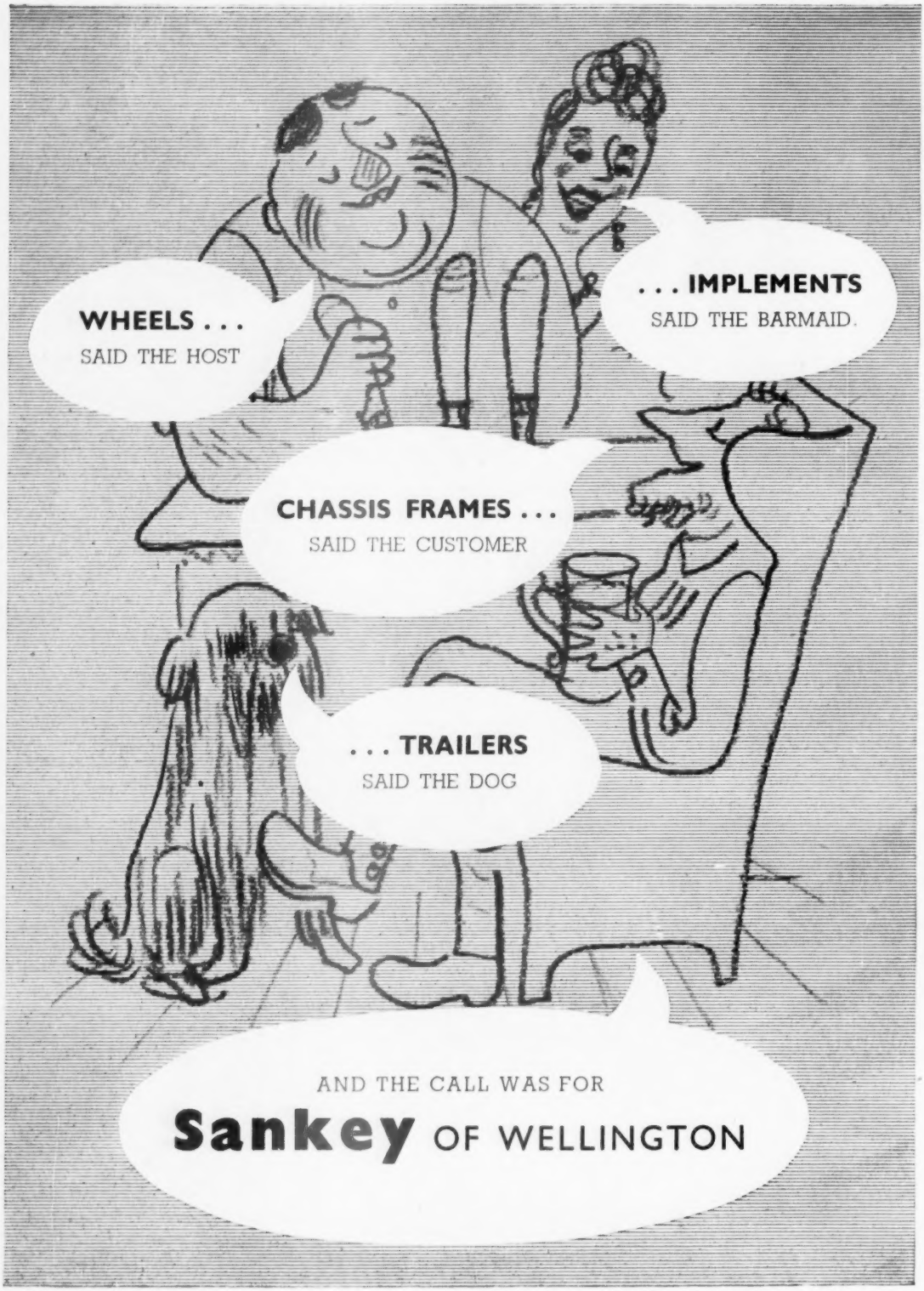


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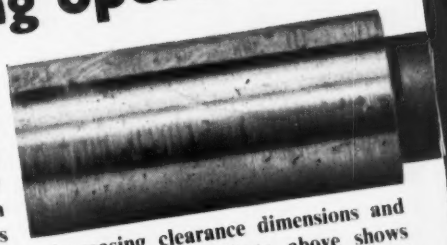
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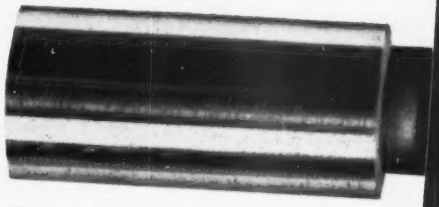
how SURFACE DEFECTS impair bearing operation

No matter how smooth a ground surface may appear, examination will reveal imperfections in the form of grinder scratches and ridges, feed spirals, chatter marks and partially loosened metal splinters. Upon contact, these minute peaks and ripples interlock with the mating surface of the bearing, tending to rupture the protective oil film. Fragmented metal is torn from surfaces to mix with lubricant and cause abrasive wear, increasing clearance dimensions and shortening life. Photo above shows an example of a scratched and galled surface which stopped rotation by "plowing" metal.



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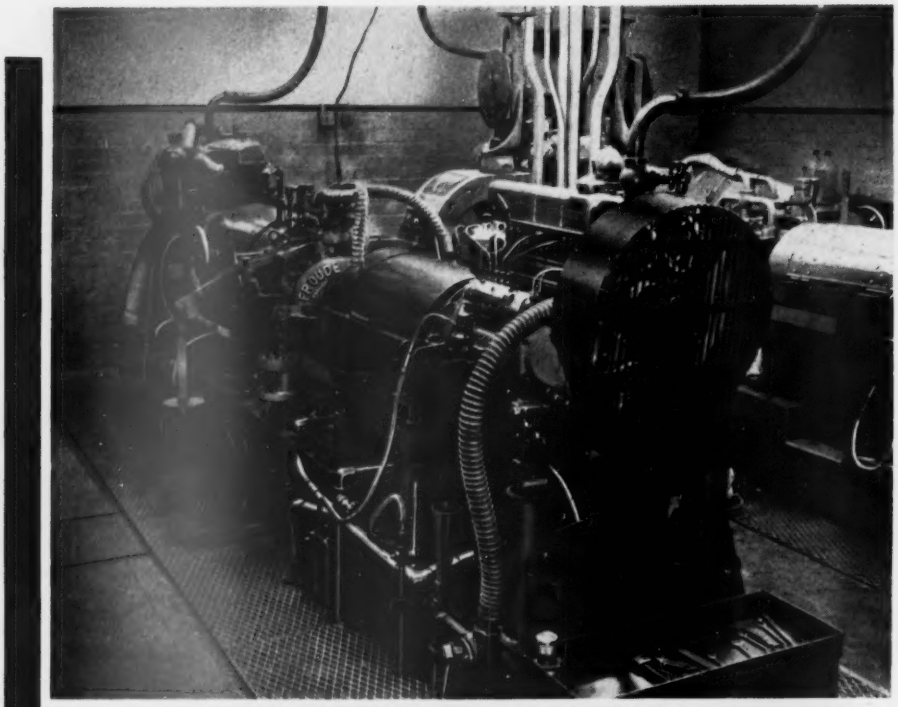
If you have not yet read the treatise "Wear and Surface Finish," we will be glad to send you a copy of this authoritative text-book with our compliments. Please request it on your company letterhead.



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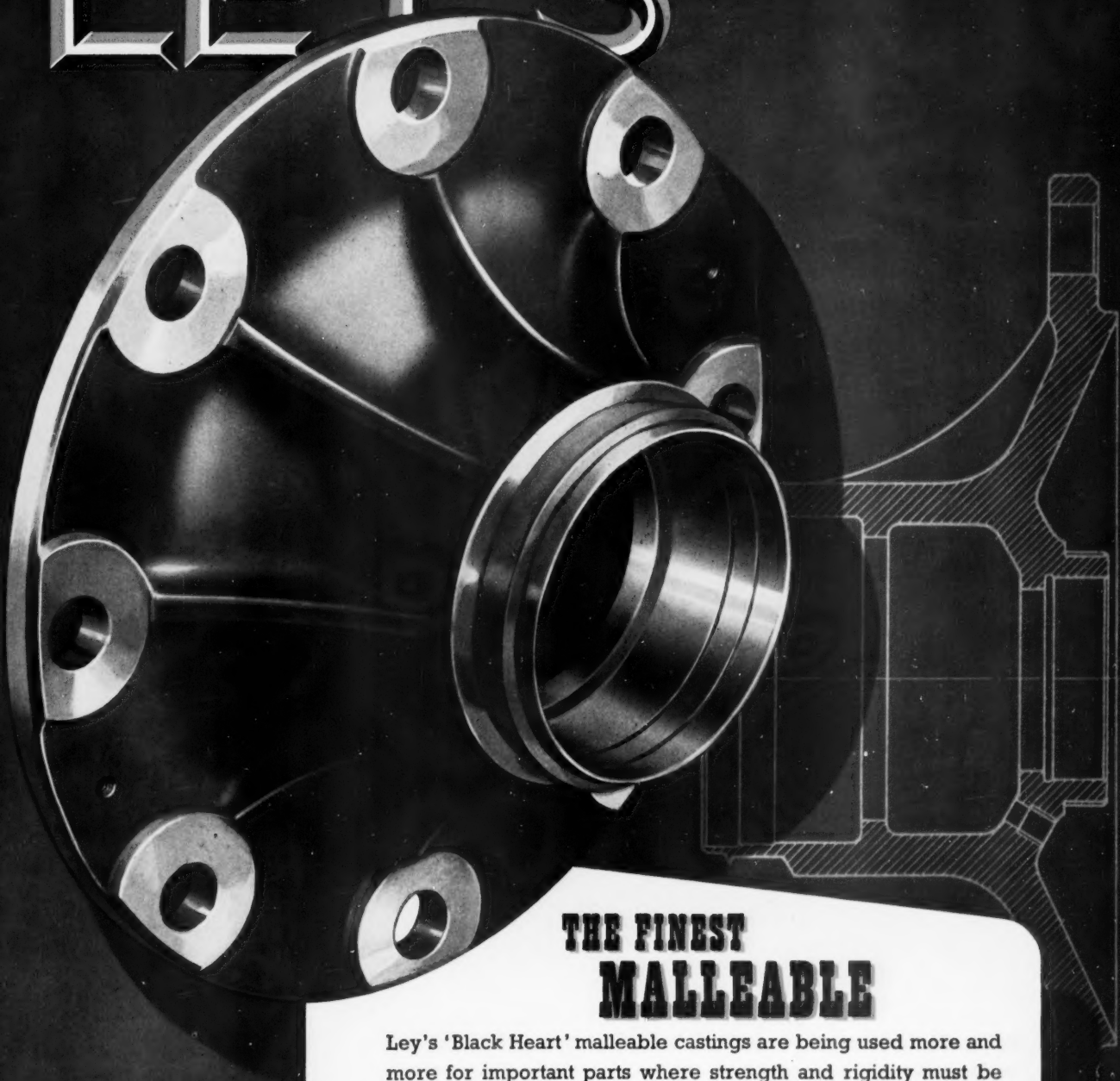
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One engine is on test while another engine at the opposite end is being prepared in readiness.

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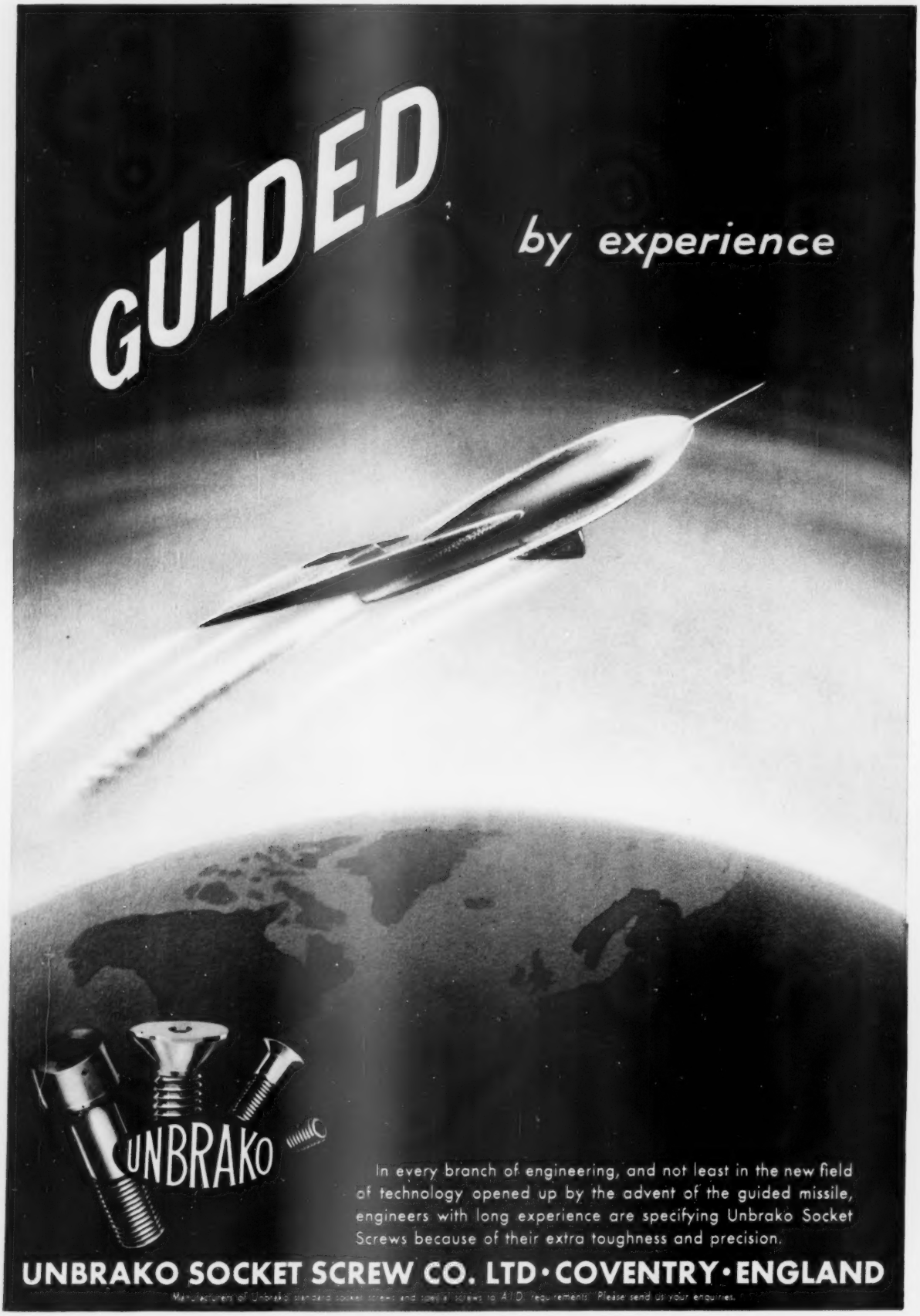
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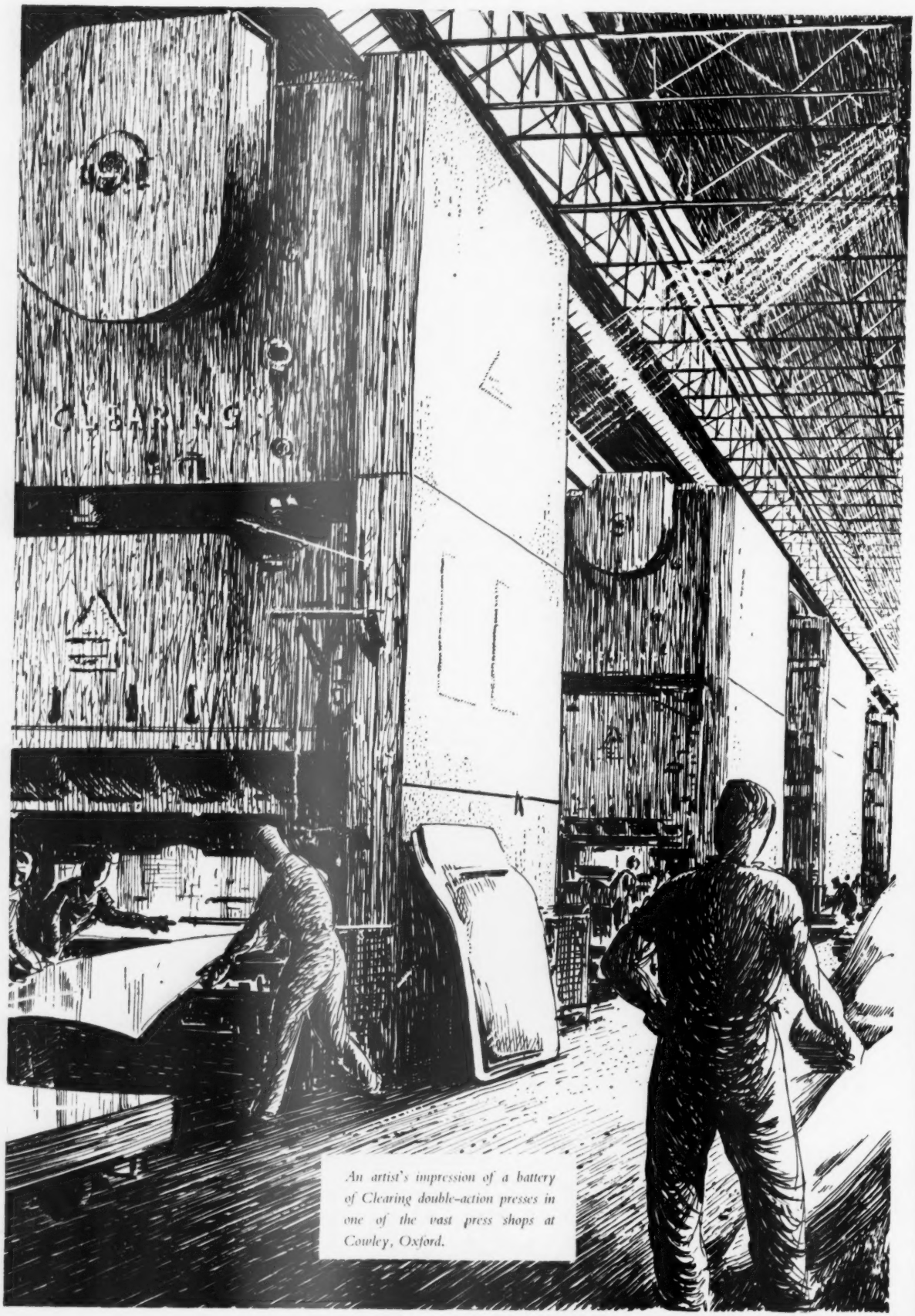
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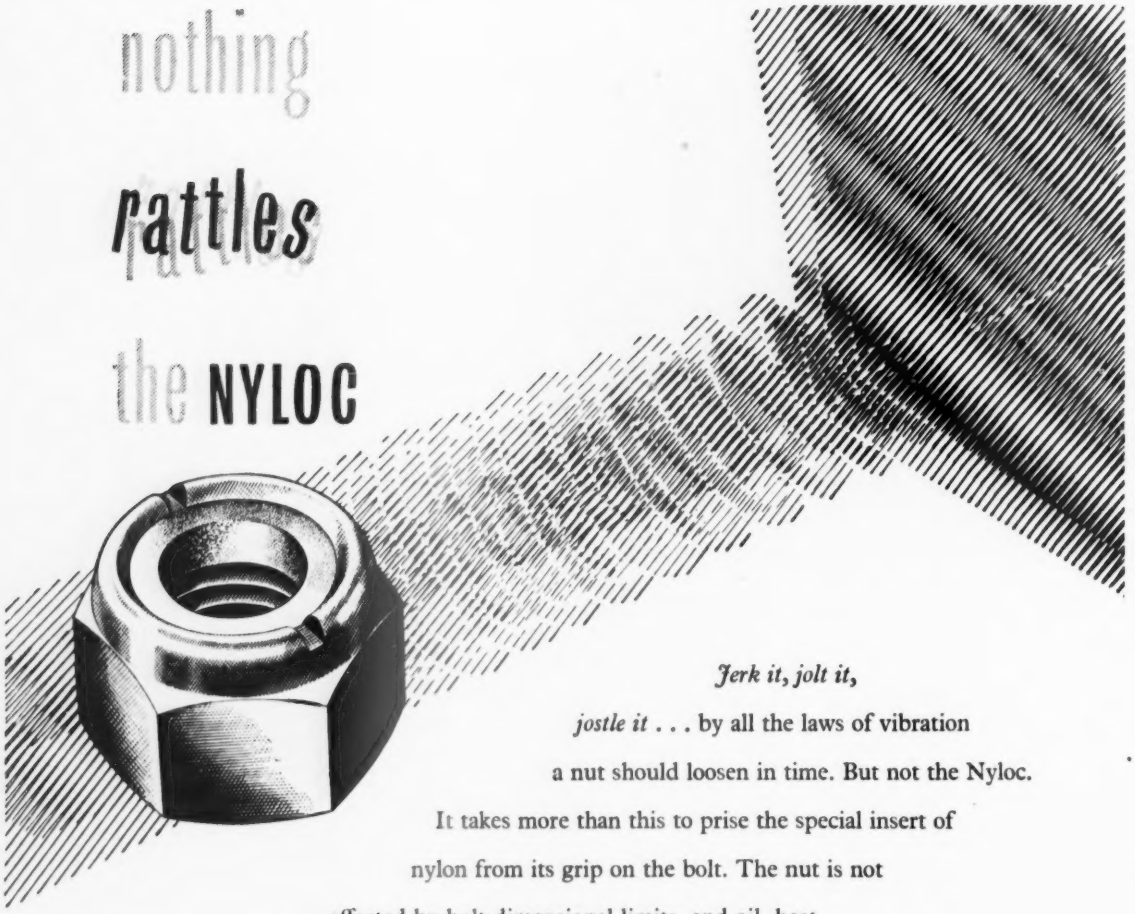
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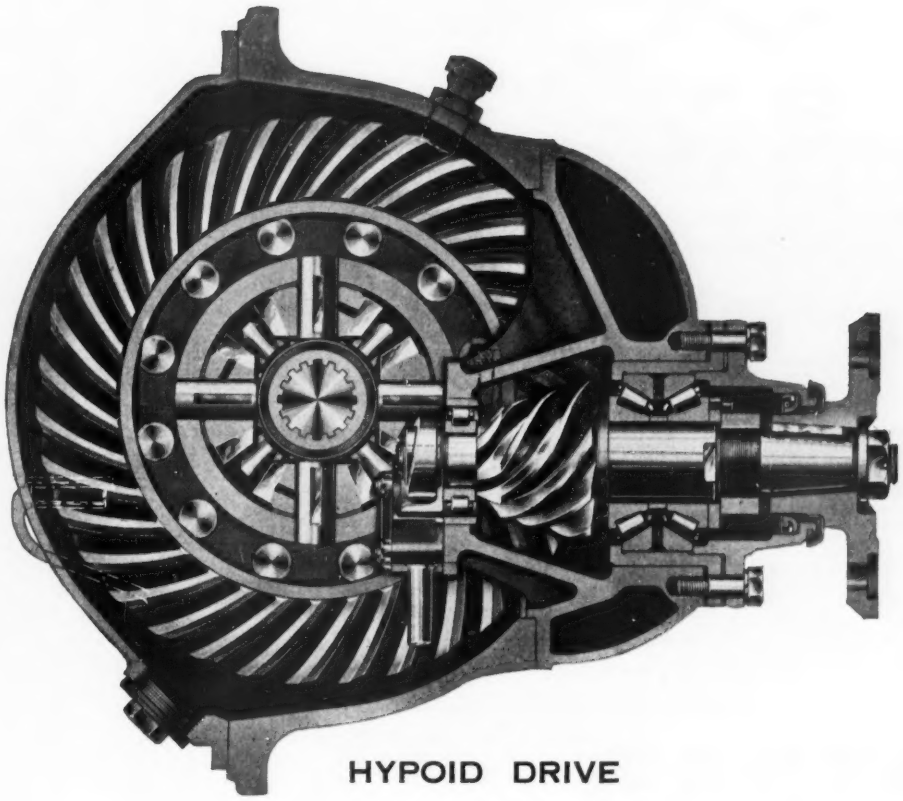
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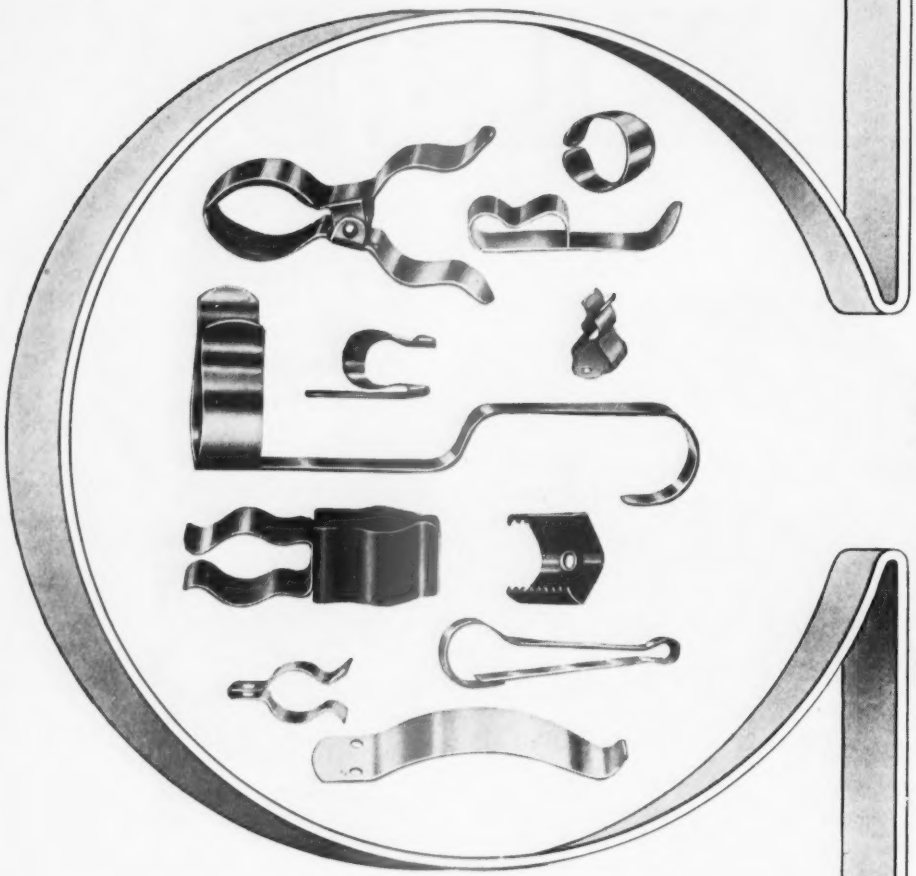
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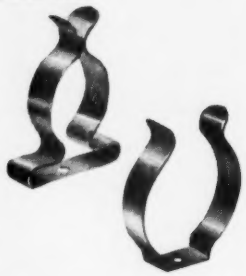
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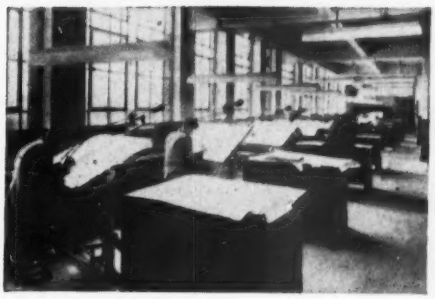
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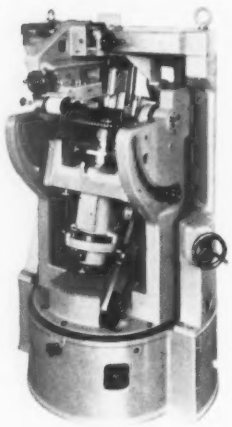
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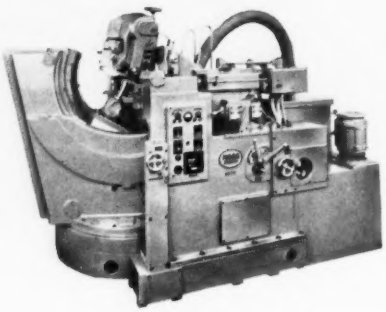
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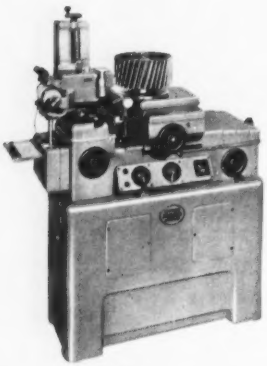
Equipment of the finest standards—designed to ensure economical high-rate production to the extremes of accuracy. The MAAG range is very complete. These machines are representative only, but we shall be pleased to submit detailed proposals based on your production requirements.



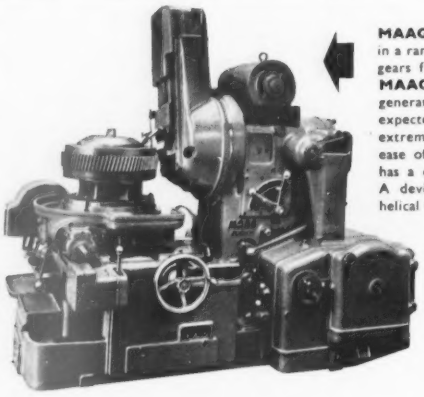
MAAG Bevel Gear Testing Machine, KP-42, is a companion to the Type KS-42 Bevel Gear Grinding Machine, right. This machine records tooth alignment, tooth thickness, tooth profile and surface finish of *bevel* gears up to 16.5 in. dia. It will measure the cone angle and the generating angle as well as the lateral displacement in the case of *oblique bevel* gears. The error magnification is adjustable between 400 : 1 and 1,000 : 1.



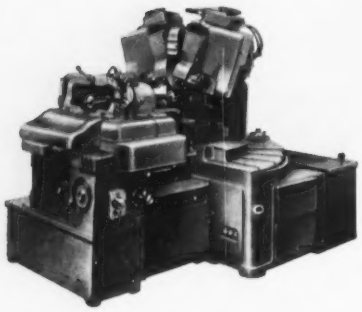
MAAG Bevel Gear Grinding Machine, Type KS-42, is a recent addition to the **MAAG** range for precision grinding involute tooth flanks and tooth gullets of straight-toothed *bevel* gears up to 16.5 in. dia. at a ratio of 1 : 8 (smaller dias. at lower ratios) This machine operates on the generating principle and is extremely accurate. Equally economical for individual gears or large batches.



MAAG Gear Testing Machine, PH-60, inspects, measures and records tooth profile, tooth alignment, helix angle, concentricity and surface finish of tooth flanks. Capacity 23 in. dia. Can be adapted for spur and helical *internal* gears. Other **MAAG** gear testing and measuring instruments are made in various types and sizes for checking pitch, profile, centre distance and concentricity with a precision of 0.00004 in.



MAAG Gear Cutting Machines are made in a range of sizes for cutting spur and helical gears from 0.8 in. to 200 in. dia. Like all **MAAG** machines, they operate on the generating system and possess all the qualities expected of modern machines including extreme accuracy, maximum efficiency and ease of operation. Type SH-75, illustrated, has a capacity from 1.2 in. to 29.5 in. dia. A device for cutting *internal* straight and helical teeth and racks can be supplied



MAAG Spur and Helical Gear Grinding Machines are made in a range of sizes up to 140 in. dia. capacity. Type HSS-10 illustrated, is a high production machine for small gears up to 4.7 in. dia. This high-speed machine features infinitely variable speeds, rapid grinding times and easy change-over. Its accuracy is easily within the fine limits required for high class gears, i.e., pitch and profile errors do not exceed 0.00008 to 0.00016 in.

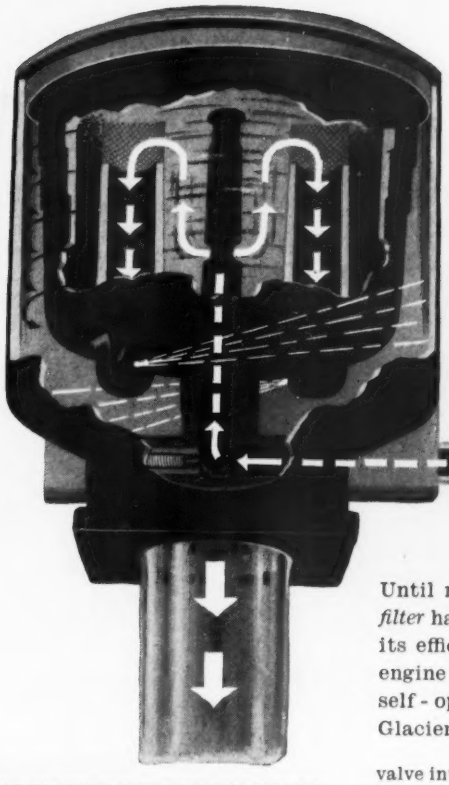
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HOW THE GLACIER CENTRIFUGAL WORKS

Like many another technical advance, the idea is basically simple. In place of filter-packs and elements, the Glacier harnesses centrifugal force (at a thousand times the force of gravity) to do the job better. Look at the sectional diagram, and you will see how *the oil itself* drives a rotor which flings the dirt to the sides of the bowl, while the clean oil flows unchecked through the hole in the base.

THE TEST OF EFFICIENCY

Too simple to work? The proof lies in working efficiency. The Glacier Centrifugal Oil Filter has been submitted to exhaustive tests and cannot be faulted. If oil is cleaned by passing through a filter medium on the principle of a strainer, efficiency at best is relative: *the Glacier Centrifugal intercepts particles that will pass through the mesh of the finest strainers in use.* Many strainers, moreover, progressively lose efficiency as they become clogged with the dirt they are trapping until the ever more restricted oil-flow and loss of pressure bring a by-pass valve into play which feeds dirty oil to the bearings. *The Glacier Centrifugal Oil Filter maintains high efficiency and constant flow.*

THE TEST OF £.s.d.

With filters of the strainer type, the relatively frequent cleaning or replacement of the strainer element is imperative. A fleet of vehicles can run up a pretty bill in a year on new elements alone. *There is nothing to replace in a Glacier Filter. There are no running costs.* Inspection and cleaning can be carried out in five minutes. The filter component, as you buy it, should last the life of the engine without any trouble or replacement of parts: it is designed for engines of 60/120 b.h.p., but larger models, and also a smaller model specifically designed for motor cars, are under development.



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2. Constant flow.
3. No replacement elements.
4. No clogging.
5. Sump filtered every few minutes.
6. Dirt capacity many times greater.
7. Easy inspection and easy cleaning.
8. Easy fitting with Glacier accessories — no independent drive required.
9. A precision-engineering job which cannot go wrong.

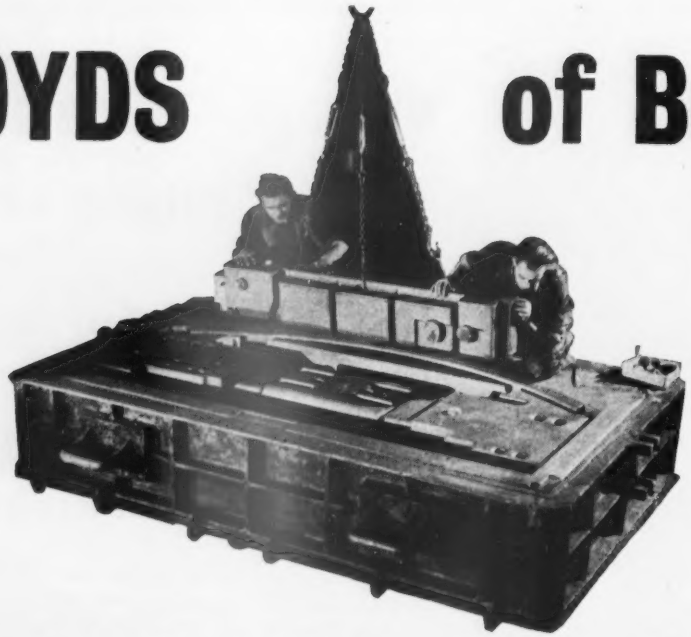
That's the GLACIER CENTRIFUGAL OIL FILTER

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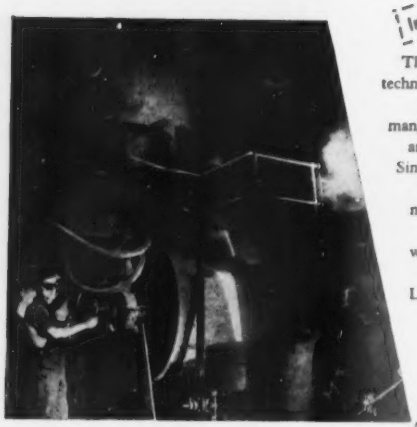
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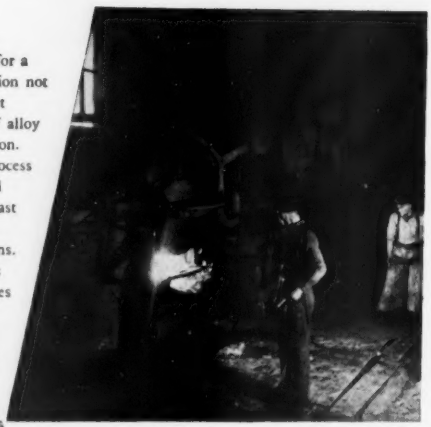
Including Ductile Iron.

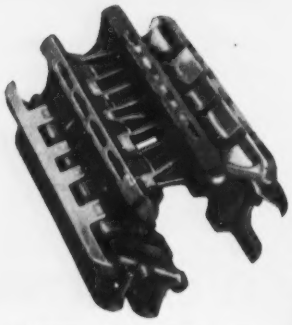
are casting Alloy Steels and High Duty Irons

Including Manganese Steel

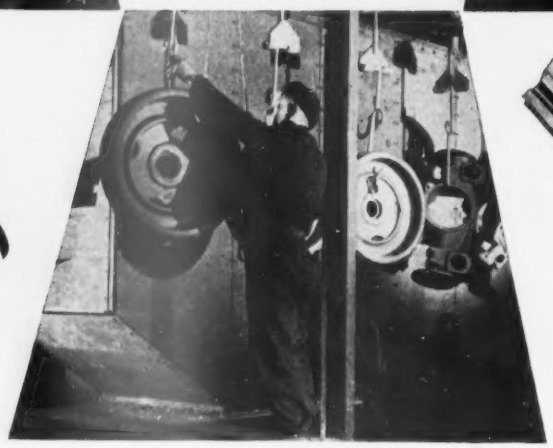


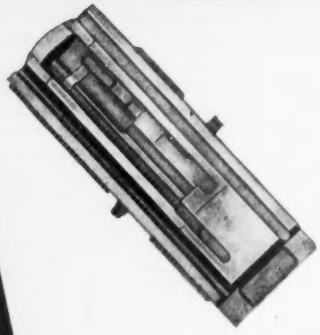
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Manganese Steel Centurion Tank Track Links approximate weight of each link 38 lbs.





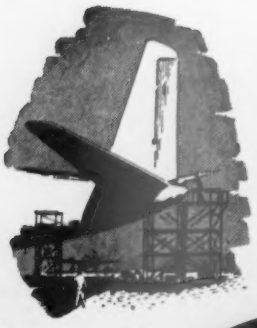
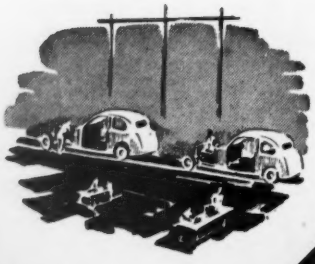
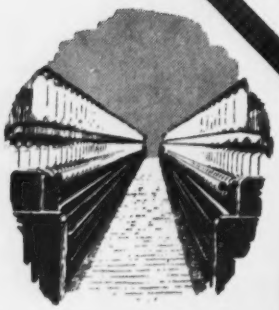
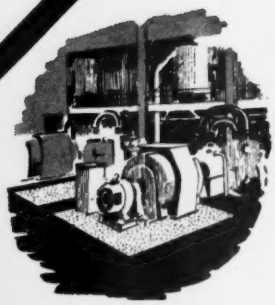
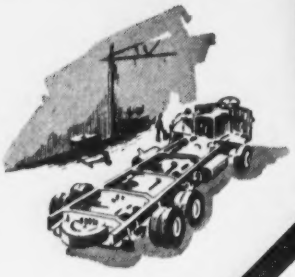
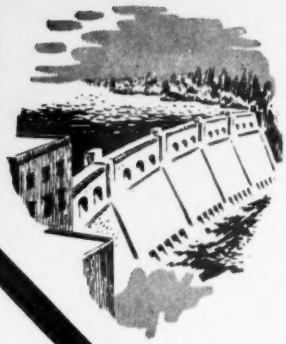
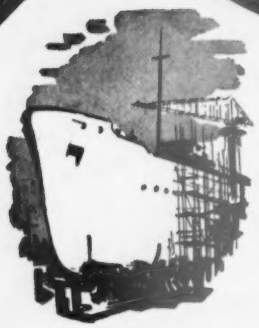
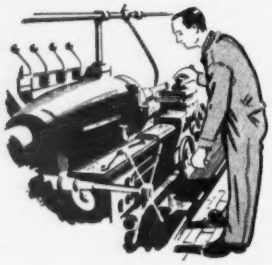
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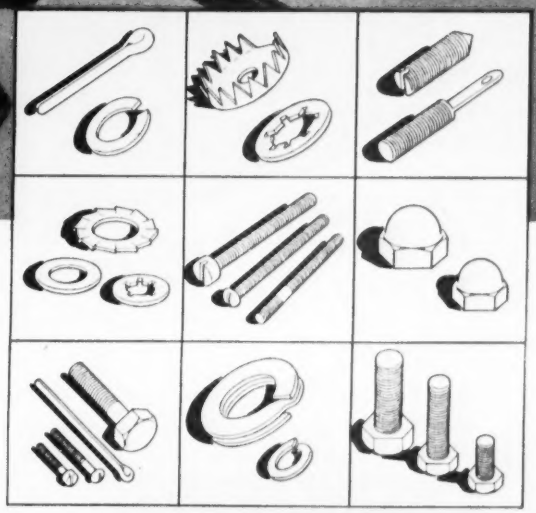
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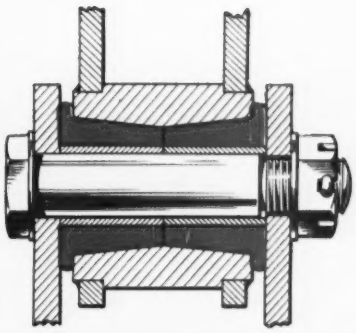
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DISPERSIONS

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Silentbloc

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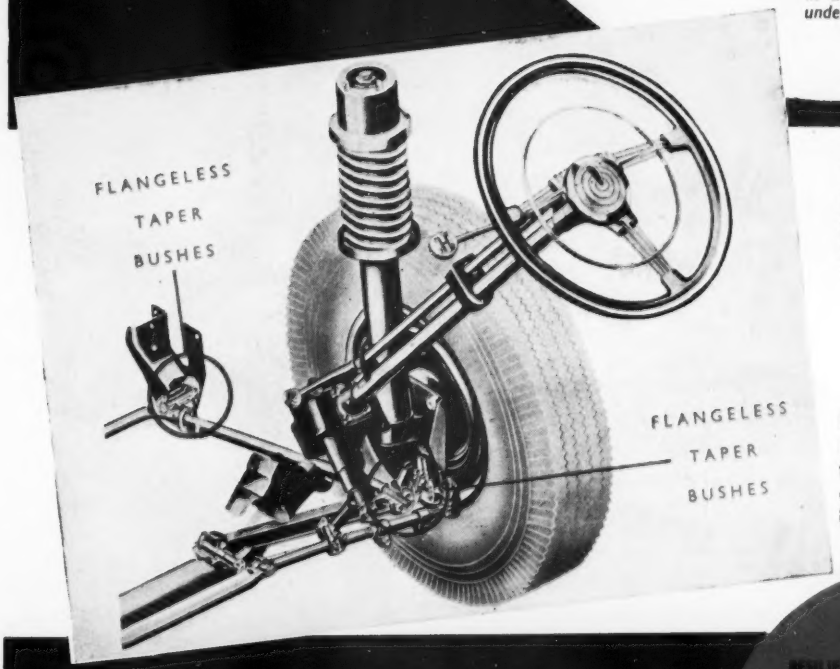


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Right: Flangeless Taper Bush sectioned to show construction. In the housing flanges develop under compression.



★After exhaustive testing Ford Motor Company Ltd. now fit Silentbloc Flangeless Taper Bushes in the I.F.S. of the "Consul" and "Zephyr Six".

Left: Front Suspension of the "Consul" and "Zephyr Six".

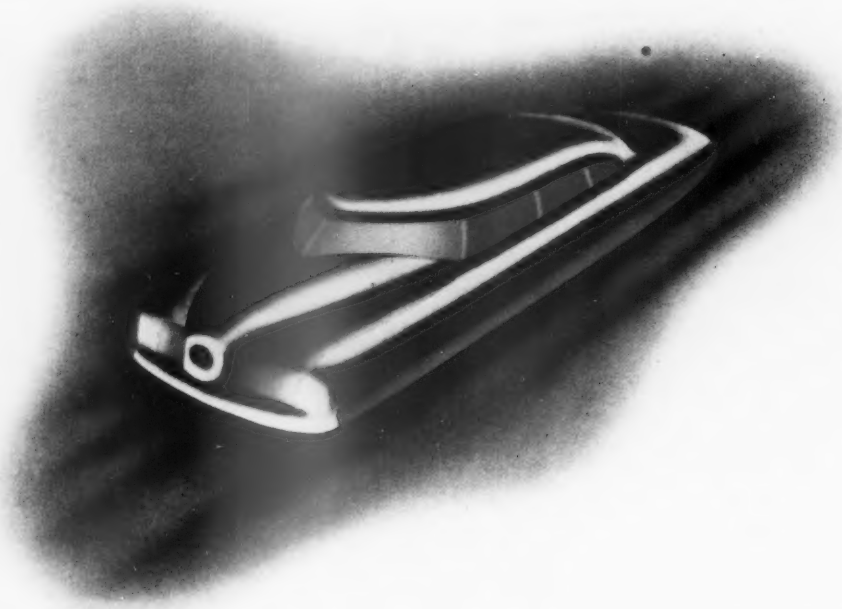
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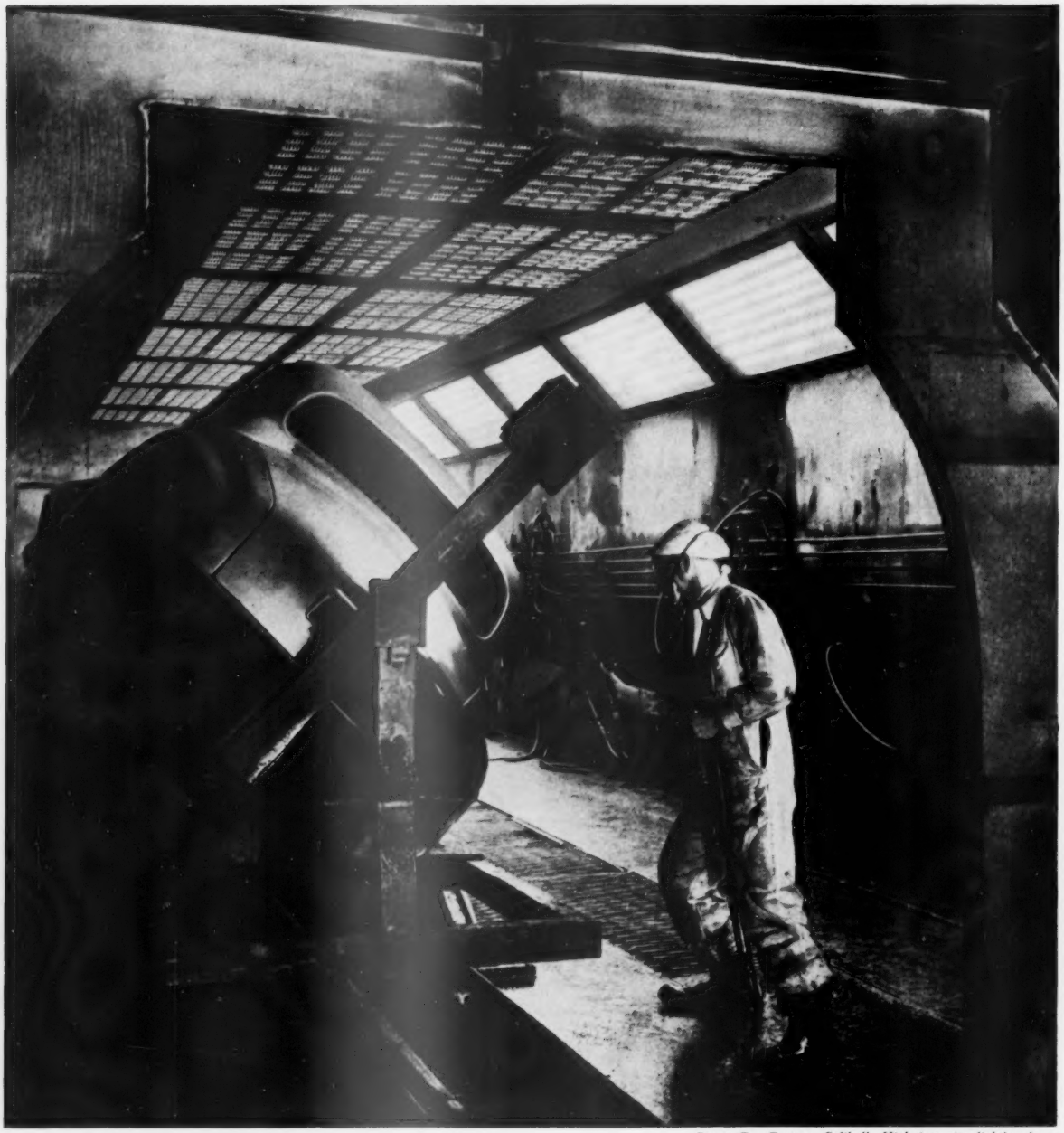
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Rover Car Factory, Solihull. High intensity lighting in a body spray tunnel by fluorescent lamps in a glazed enclosure.

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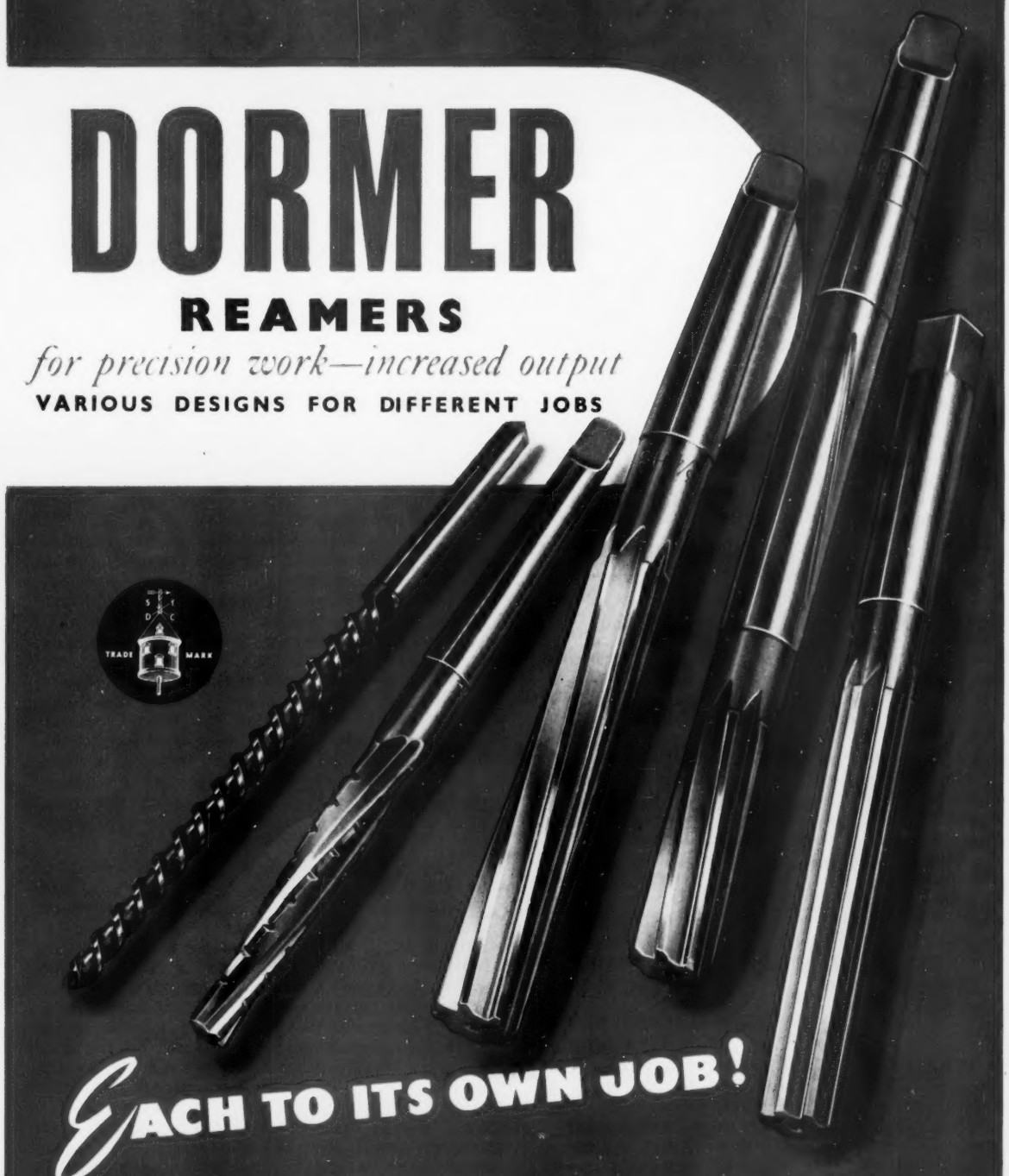
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G35

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The London Show

PROBABLY there were three reasons for the record crowds at the Show. The first was that all sales were covenant-free, and immediate delivery could be obtained for many types. Secondly, there was an exceptionally large number of new models to be seen, and the third reason was that cars in the popular 800-1,200 cm³ range were well represented among the new exhibits.

In some quarters it is said that there are too many of these sizes on the market. However, a comparison between the numbers of models in the different categories of vehicles, up to about two litres, will show that this view can hardly be fully justified. Nevertheless it may be necessary in not very distant future to make a positive effort to sell these small cars. Competition is likely to be keen in the home market, and this will be a powerful incentive to better the product; moreover, these improvements will tend to make it more acceptable overseas.

Engines

Modern engines, as applied to motor vehicles, have long ago reached such a degree of efficiency that no single innovation is likely by itself to effect a marked advance so far as performance is concerned. In these circumstances, further progress can only be effected by the cumulative effect of detail improvements. For this reason, what appear to be only minor changes in design are, when taken in aggregate, of appreciable significance. However, there is one direction in which considerable headway remains to be made. This is in reducing servicing costs, both by increasing the life of components most subject to wear, and by improving accessibility.

Labour charges represent a high proportion of nearly all servicing bills. Therefore, much goodwill may be gained by increasing accessibility and making possible the removal of each component without its being necessary first to take off or partly to dismantle adjacent units. The problem of providing adequate space round an engine installation is most acute in the small cars. However, that it can be solved is especially well demonstrated in the new Ford Anglia and Prefect models.

Perhaps one of the most noteworthy detail design features among those which, even on the smaller engines, are becoming increasingly popular is the coolant distributor tube employed to direct water over what are normally the hottest parts of the cylinder head and porting system. This device has been used for many years on a number of the larger power units, but small engines are no less subject to valve seat distortion troubles and subsequent valve failures which may be avoided by better cooling.

Induction systems, in general, change but little from year to year; nevertheless, the thermostatically controlled, exhaust heated hot-spot is becoming more widely adopted. Where this type of control is not employed, on account of the added cost it introduces, the aim should be to restrict the size of the hot-spot and to position it immediately below the inlet riser. In this way it may perform its function of evaporating the heavier droplets of fuel which, because of their inertia, are carried on to this portion of the manifold. If the hot-spot is too large it seriously reduces the volumetric efficiency of the unit.

On many foreign produced vehicles the air cleaner and silencer units are much larger than on British cars. Units of such sizes are certainly desirable in some overseas countries but are not necessary at home. When they are employed, they should be adequately stayed; for die-cast zinc alloy carburettor bodies are not strong enough to carry the fatigue loads applied by these heavy units, which are invariably positioned a relatively long way from the axis of oscillation of the engine. In order to accommodate a large cleaner and silencer within the space available it may be necessary to design the unit so that it surrounds the carburettor rather than rests on top of it. In this case, it obviously should be quickly and easily removable so that adjustments to the carburettor can be effected.

Transmissions

In the industry there is a general air of expectancy concerning transmissions; for it is well known that behind the scenes developments on automatic units of various kinds are proceeding apace. It seems reasonably certain that two-pedal control systems for quantity produced cars will be introduced, probably within the next year or two. That manufacturers should give very careful consideration to the problem and engage in extensive development work before tooling-up for such a venture is not surprising. The American transmissions in many cases are not entirely satisfactory, and in view of the tooling commitments already involved, it is not practicable to make sweeping changes in design in order to remedy defects revealed in service. Rather have they had to compromise by making minor modifications.

So far as British manufacturers are concerned, several possible lines of approach to the problem are possible.

One is to design a hydrodynamic drive and planetary gearbox system on the lines of the American units. This involves the investment of millions of pounds on tooling for a design that almost inevitably will have its teething troubles, which may well involve both loss of goodwill and further investment in tooling. Moreover, there is the decision to be taken as to what size of unit to produce. To keep costs as low as possible, the large market in the smaller family saloon car class must be catered for. On the other hand, it would not be practicable to offer the smaller cars with two-pedal control and the more expensive ones without it. Therefore, more than one size of automatic transmission apparently would be needed. This would further increase the financial commitments and the risk.

Another line of approach, which has much to recommend it, is to use well-tried components which are already available and most of which are fully tooled-up. The system envisaged incorporates a centrifugal clutch instead of the hydrodynamic drive. This would overcome the difficulty of developing a torque convertor of acceptable efficiency for countries such as ours, in which fuel costs are high. The clutch unit, together with some types of automatic withdrawal arrangement, for instance, of a form similar to that of the Manumatic system, would be employed in conjunction with a three-speed gearbox, incorporating overdrive on top and second speeds. De Normanville overdrive units already have been developed to the stage where the change is effected automatically by torque and speed sensitive control units, so little further work should be required to bring such an arrangement into large scale production. If the gear and axle ratios were suitably chosen, starting from rest could be effected in direct second speed, and in addition to there being automatic up and down changes between second and overdrive top speeds, all the advantages of the overdrive unit would be gained. Hand selection, for bottom gear, would only be necessary on exceptionally steep hills; reverse, of course, would also be obtained by manual selection. Supplementary devices for fast idling when starting from cold would also have to be incorporated, as well as a means of engaging the clutch should a tow start ever be necessary.

In the conventional gearboxes, the most noteworthy advances concern lubrication. Until recently, it has been the practice to provide positive lubrication to the mainshaft gear bushes in only the more expensive high-performance cars. However, although positive failures are less likely to occur in smaller cars, they are not unknown. Furthermore, because of the tilting effect associated with helical gears, there is a tendency for the bushes to wear at their ends, and for the gears to become noisy. This can be avoided by adequate lubrication of the bushes.

The method of lubrication adopted in the Standard Eight is simple and effective, the pumping action, being effected by a scroll on the shaft inside the lay-gear cluster. It is not sufficient partially to submerge the layshaft gears in the oil and to rely on splash for lubrication of the mainshaft, as is done in many other designs; for this reduces transmission efficiency and, in any case, centrifugal action tends to keep splashed oil out of the mainshaft bushes.

Suspension and frames

Several new suspension units using rubber as the springing medium are in the course of development. There may well be a demand for these systems, for they have a number of advantages. Rubber has inherent damping properties which may relieve the shock absorbers of some of their work. Alternatively, the hysteresis of the rubber might be used to damp the low-frequency, ride vibrations, in a suspension system fitted with a dynamic absorber, such as the type employed to deal with wheelhop in the Citroen 2CV. Among the other advantages of rubber are silence, the ease with which a variable rate may be introduced, and simplicity of the sub-assembly.

Disc brakes have been given much publicity over the past year or so. However, until they have been developed further, and can be produced at a competitive price, there is not likely to be a great demand for them. The situation so far as the family saloon cars are concerned is that if better braking than is at present available on any particular model is required, the most economical way to obtain it is to fit larger diameter drum-type brakes. However, if the wheel rim diameter is too small to accommodate units of this type, the alternative is to fit disc brakes.

Increasing popularity of chassisless construction has greatly restricted the number of vehicles suitable for conversion by the specialist coachbuilders. The solution frequently adopted by the smaller manufacturers has been to fabricate a frame from steel tube, and to employ mechanical components, such as suspension and steering units, supplied by one or other of the larger manufacturers. Frames of this type are relatively simple to repair, and spare parts for the mechanical components may usually be obtained relatively easily. However, it is possible to design chassisless vehicles in such a way that conversions are practicable; and greater attention might well be paid to this aspect.

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EARLS COURT EXHIBITION

A Review of Design Trends

ENGINES

Manufacturers Retain their Traditional Layouts in the New Models

THE London Motor Show, which was open to the public from the 21st to the 31st of October, 1953, was characterized by the introduction of a relatively large number of new models. Although the engines of many of these vehicles were also of new design, most manufacturers adhered to their earlier policies so far as general layout was concerned. For instance, the Ford Motor Co. Ltd. have retained the side-valve arrangement in their new Anglia and Prefect, while the latest Rover models feature the F-head that has been so successful in earlier designs. On the other hand, a push-rod operated, overhead-valve arrangement, with a low camshaft, has been adopted in the Standard Eight.

Among the more interesting exhibits were the diesel engines for installation in private cars and taxis. The Perkins P4 unit, which has been fitted experimentally in a number of different chassis, was on view in the gallery. On the ground floor, the Mercedes-Benz and Borgward diesel units were shown.

When considering the application of diesel engines to private cars, one of two policies must be followed and it seems unlikely that any compromise is possible. Either the unit must be designed specifically for this type of installation, or an engine must be used which is suitable for a wide range of applications including trucks, passenger transport vehicles, stationary duties and marine installations. When designing a unit for a private car, particular care must be taken with crankshaft balancing, and close tolerances must be specified, a combustion system giving smooth running and easy cold starting should be adopted and a number of other features can be incorporated to make the installation more acceptable than are most units of this type. On the other hand, if an engine of more universal application is used, it will probably be less compact, more noisy, and installation problems may be less easy to overcome. However, the cost is almost certain to be appreciably less.

On the more conventional petrol engines, a number of changes have been made. Perhaps the most marked general trend was towards slightly higher compression ratios. This, of course, has been the result of the relaxation of restrictions on the sale of better fuels in this country. Most manufacturers have increased their compression ratios by machining a small amount from the cylinder head face joint, but at least one has adopted higher-crowned pistons. It would not be safe to infer, where the heads have been machined, that models manufactured before the introduction of the change may be modified in a similar manner.

In some cases, steel gaskets have been used, following the adoption of the high compression ratio. These gaskets have channel sections, loosely termed corrugations, impressed round the bores, coolant ducts and stud holes. The impressed sections form an effective seal when initially fitted but it is generally wise to use a new washer after the head has been removed from the engine for servicing. Steel washers probably have a slight advantage in that their conductivity is better than that of the asbestos packing used between the copper facings of the more conventional gaskets, but the main reason for fitting them is that they are better in withstanding the higher pressures.

Split- or slotted-skirt pistons continue to be favoured for most private-car engines except in the high-performance units. In these, plain skirts are generally used and it seems hardly likely that this policy will be changed, unless some unforeseen development of a revolutionary nature arises. Greater tolerances are permissible with split- or slotted-skirt pistons, which are generally quieter. However, they are not capable of standing up to the heavy loading imposed upon them in the high-powered, light engines used for sporting or racing purposes. Most manufacturers fit all three piston rings, that is, two compression and one oil-control ring, above the gudgeon pin. A second oil control ring is not fitted near the base of the skirt because the extra cost involved is not justified by the additional benefits that may be obtained. Chromium-plated top rings are becoming increasingly popular because of the reduced bore wear associated with their use. Although they are certainly effective up to a point, it is difficult to see how they can cater for cylinder distortion.



Electric motor-driven fan on the Jowett R4

Cylinder liners are not generally favoured for the smaller engines. Nevertheless, there is a strong case for their adoption because of the reduced bore wear that is experienced with them, and because they materially reduce, and in many cases eliminate, distortion troubles. Admittedly, the initial cost of engines fitted with liners is greater, but this handicap is more than counterbalanced by the reduced servicing costs.

Few changes have been made in lubrication system design for the engines of quantity-produced cars, but in the coolant systems some interesting features were to be seen at the Show. The Standard Eight has a distributor tube in the cylinder-head water jacket to ensure that the coolant is directed where it is most needed; this feature is not new but hitherto it has not often been incorporated in engines of this size. A double-sided impeller is employed on the Riley Pathfinder; one side circulates the water for the main cooling system while the other serves the heater. This is one way of effecting a much needed improvement in heater efficiency.

A noteworthy feature of the Jowett R4 is the electrically driven radiator fan. A $\frac{1}{6}$ h.p. D.C. motor of AC-Delco manufacture is employed and it takes a current of three to four amperes. The switch unit is situated in the radiator header tank and it brings the fan into operation when the water temperature rises above a predetermined value and then, when the temperature falls, cuts it out again. In this installation, a very short shroud ring is positioned round the fan to increase efficiency. This arrangement has been found to be better than fully shrouding the fan and radiator.

There are several advantages to using a separate motor and automatic switch arrangement. When a fan is most needed, that is, when climbing slowly up a steep hill or when idling under heavy traffic conditions, the normal belt drive turns it too slowly to be

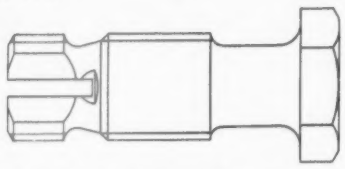
really effective. On the other hand, when running normally at high cruising and maximum speeds, there is a tendency for the engine to be overcooled. Moreover, the belt-driven fan running at maximum engine speed may absorb as much as 2 h.p. All these disadvantages are overcome by the use of a separate electric motor for the fan, and in the R4 the increased efficiency thus obtained has enabled a reduction of 20 per cent to be made in the radiator size. With this arrangement, the fan runs at more or less constant speed, so that it may be designed in such a way that maximum efficiency is obtained at that speed and the power absorbed is small. In addition, by incorporating the thermostatically controlled switch, the unit is brought into operation only when it is really needed, so little or no power is wasted.

Quantity-produced small cars

Although British manufacturers have not seen fit to offer very small, low-powered cars, such as are made on the Continent, competition in the nominal eight- and ten-horse power class is probably becoming as keen as it has ever been in the history of the British motor industry.

The lowest-priced vehicle is, of course, the Ford Popular model, and it is powered by the well-proved 1172 cm^3 engine that was formerly fitted in the Prefect and the export Anglia. This unit produces 30·1 b.h.p. at 4,000 r.p.m. Another new model that has been introduced by Ford is the Zodiac, which is basically the same as the six-cylinder Zephyr. So far as the engine is concerned, the only alteration has been to increase the compression ratio from 6·8 : 1 to 7·5 : 1. This has been effected by reducing the overall depth of the cylinder head by 0·050 in by removing this amount from the joint face. However, it is important to note that the Zodiac head has been specially designed for this feature, so this modification cannot be carried out on the standard Zephyr engines by machining the lower face.

The new engine that Ford have introduced is the four cylinder, 1172 cm^3, side-valve unit for the latest Anglia and Prefect models. Its bore and stroke are 2·5 in by 3·64 in (63·5 mm by 92·5 mm) and it develops 36 b.h.p. at 4,400 r.p.m. At 2,150 r.p.m., the maximum torque of 54 lb-ft is developed, and the maximum b.m.e.p. is 114 lb/in^2. The compression ratio is 7 : 1.



The Ford self-locking tappet adjuster screw

Although superficially it might appear that this engine is similar to the earlier one, which is now used in the Popular model, the power output and engine speed have been appreciably increased, so it is obvious that considerable changes in detail design must have been made. The cylinder dimensions of the earlier and the latest models are identical, and a number of other features are common, so that it has been possible to make use of much of the existing tooling in the production of the new engine.

At the engine speed at which maximum b.h.p. is developed, the mean piston speed is 2,670 ft/min. A stroke : bore ratio of 1·46 : 1 has been adopted, and the connecting rod length : stroke ratio is 1·683 : 1. The engine output in terms of b.h.p. per square inch piston area is 1·83. A dry weight of approximately 222 lb is quoted, so that the b.h.p. developed per pound is 0·162.

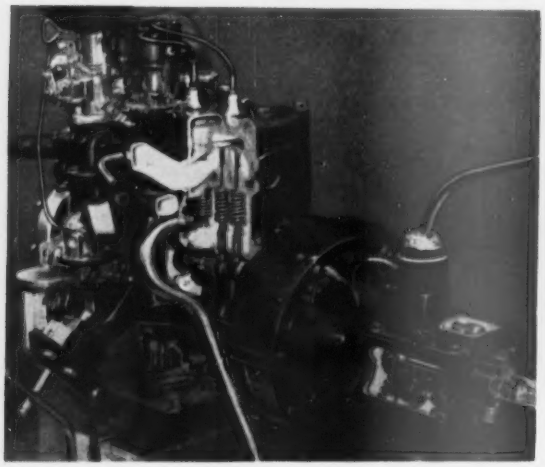
Brackets bolted to the side of the cylinder block carry the rubber sandwich mountings at the front. At the rear end of the gearbox extension, two rubber pads in shear support the unit. The engine is installed with its longitudinal axis inclined 2 deg 30 min from the horizontal, to make the body floor as free as possible from obstruction.

An integral crankcase and cylinder block of cast iron is employed, and the cylinder wall thickness is 0·18 in. Three bearings carry the dynamically balanced cast-steel crankshaft which is located at the rear main journal by split thrust washers. This crankshaft is different from that of the earlier engine, in that the journal diameter is now 2 in, instead of $1\frac{5}{8}$ in, and the crank pins are approximately 1·7 in instead of 1·5 in diameter.

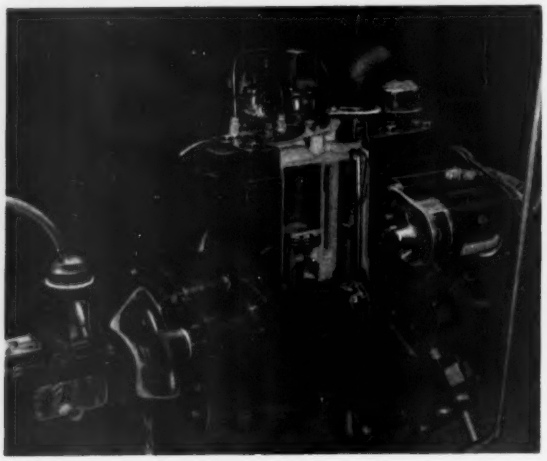
These alterations have increased the stiffness of the crankshaft and have provided larger bearing areas to cater for the greater loads. Vandervell, steel-backed, micro-babbitt shells are employed. At the rear of the crankshaft, the seal is a rubber-impregnated asbestos packing. The end bearing caps are totally enclosed in the sump. The cast iron flywheel is 9·12 in diameter and measures 10·124 in diameter over the ring gear. It weighs approximately 12·88 lb with and 11·23 lb without the ring gear.

Alloy steel connecting rods, of H-section and with a centre-to-centre length of approximately $6\frac{1}{8}$ in, are employed. The bearing caps seat at an angle of 90 deg to the longitudinal axis of the rod. Cap location is effected by two close-fitting, holding down studs, screwed into the rod. Babbitt metal is run into the big ends. At the small ends, cold-rolled strip bronze bushes are fitted, and their internal diameter is 0·6878-0·6881 in. Axial location of the gudgeon pin is effected in the usual manner, by means of circlips in the piston bosses. The Autothermic aluminium alloy pistons carry two compression rings and one Phormicast slotted oil-control ring, all of which are above the gudgeon pin. The top ring is chromium plated while the lower compression ring is of cast iron with a stepped outer face.

A Reynolds $\frac{1}{8}$ in pitch, two-strand



A new 1,172 cm^3, side valve engine is employed in the latest Ford Anglia and Prefect models



On the 1,172 cm^3 Ford engines, the water outlet is to the right of the centre of the cylinder head

timing chain transmits the drive to the cast-iron camshaft. No chain tensioning device is employed. Axial location of the camshaft is effected in the conventional way by means of a thrust plate interposed between the flange on the shaft and the front of the crankcase, and a spring-loaded plunger in the timing cover bears on the end of the shaft. The inlet valves are larger than those of the earlier engine, and the Silchrome exhaust valves are smaller. The throat diameters are respectively 1·057 in and 0·957 in, and the valve lift is 0·28 in. A tappet clearance of 0·0115-0·0135 in has been adopted and it is now adjustable, whereas in the earlier models it was not.

Mushroom type tappets of the usual form are employed, but the adjuster screw, carried in the top end of each is self-locking. The lower end of this screw is slotted, and the periphery round the slotted portion is threaded, $\frac{5}{16}$ in diameter UNF, for a length of 0·17 in. Then it is undercut for a length of 0·2003-0·2013 in, beyond which the thread is continued for approximately 1·5 in. The length of the undercut is about 0·006-0·007 in less than it would have to be to accommodate five turns of the thread. This means that the slotted lower threaded portion tends to close slightly and ride up the slope of the flank of the threads in the tappet to lock the unit. Adjustment is simply effected by the use of two spanners.

The cast-iron cylinder head is held down on its copper and asbestos gasket by fourteen $\frac{7}{16}$ in diameter bolts. Separate exhaust and siamesed inlet ports are incorporated. The combustion chambers are of the flat-topped, wedge form commonly used in side-valve engines. Both manifolds are of cast iron and the exhaust-heated hot-spot is thermostatically controlled. A Solex downdraught carburettor, with a 21 mm choke, is fitted. The water pump is on the front of the cylinder block and it directs the coolant through a distributor tube which ensures that the hotter parts, such as the exhaust valve seats, are adequately cooled. A thermostat is carried in the coolant outlet and a fin and tube radiator is employed. Lubrication is effected by means of a gear-type oil pump and the relief valve is set to blow off at about 30 lb/in^2. A replaceable type by-pass filter is incorporated in the lubrication system. The sump capacity is 4 pints.

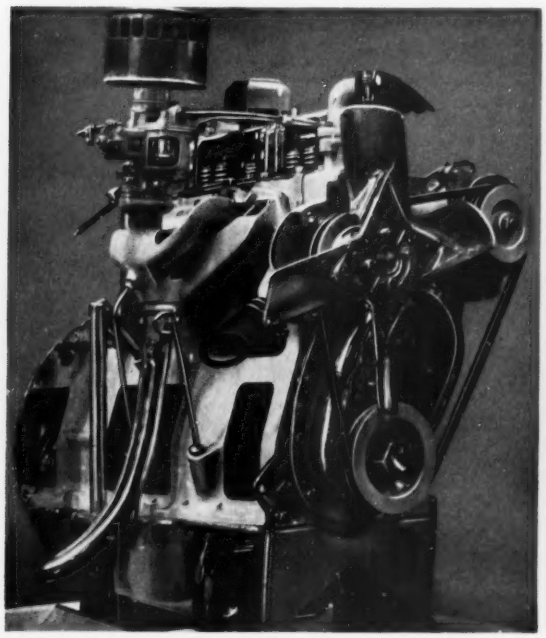
Another vehicle entering the highly competitive small car field is the Standard Eight. It is powered by a four-cylinder, 803 cm^3 engine, developing 26 b.h.p. at 4,500 r.p.m. The bore and stroke of this unit are 58 mm and 76 mm respectively and the compression ratio is 7·4 : 1. At 2,800 r.p.m. the maximum torque of 38·2 lb-ft and the maximum b.m.e.p. of 120 lb/in^2 are developed. The engine is an overhead valve unit, with the usual low camshaft, push rod and rocker valve-operating mechanism.

The stroke : bore ratio is 1·31 : 1 and the connecting rod length : stroke ratio is 1·925 : 1. At 4,650 r.p.m., the mean piston speed is 2,320 ft/min. In terms of b.h.p. per square inch piston area, a figure of 1·58 is obtained for the power output. The dry weight of the unit is 284 lb, so that the power output expresesd in b.h.p/lb is 0·092. It is stated that the aim in the design of this engine has been not to over-stress it, but rather to provide economy of operation and long, trouble-free service. Metalastik engine mounting units are employed. The system comprises a V-arrangement of two rubber-to-metal bonded sandwich units at the front and a slotted Metaxentric rubber bush, with its axis positioned transversely, forms the rear support. The engine installation angle is 6 deg from the horizontal.

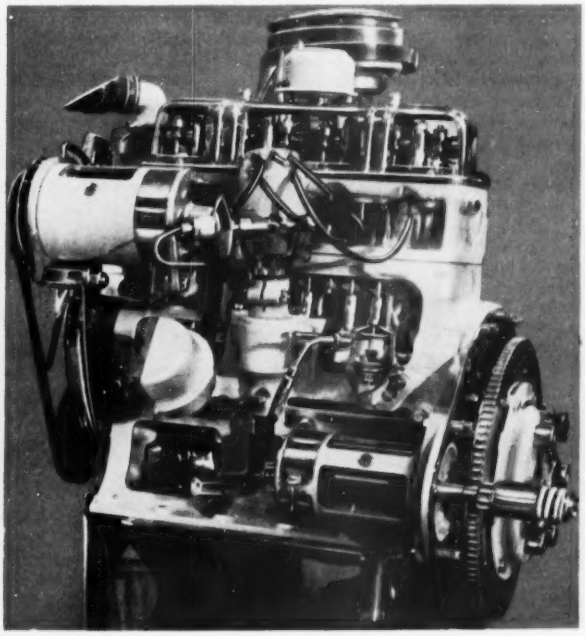
The cylinder block and crankcase unit is of cast iron and the cylinder wall thickness is approximately $\frac{3}{16}$ in. A forged steel, three-bearing crankshaft is employed and it is located by semicircular thrust washers, one on each side of the rear main journal bearing housing. The main journal diameter is about 2 in and that of the crank pin is approximately $1\frac{3}{8}$ in. Vandervell, white-metal lined bearing shells are fitted. At the rear, a light cast iron flywheel is spigoted and bolted on to the end of the crankshaft. The overall diameter of the flywheel and ring gear is $11\frac{1}{8}$ in, and the thickness of the flywheel rim is $\frac{1}{2}$ in.

H-section connecting rods are employed and their centre-to-centre length is $5\frac{1}{4}$ in. The big ends are split at an angle of about $38\frac{1}{2}$ deg from the axis of the rod, and the caps are located by means of dowel tubes round the set bolts securing them to the rod. At the small end, a Vandervell, lined steel bush is fitted. The gudgeon pin diameter is approximately $\frac{3}{8}$ in, and its axial location is effected by circlips in the piston bosses. Aluminium alloy slotted-skirt pistons are employed and each has three rings fitted above the gudgeon pin. The top one is a plain compression ring, the second is a taper-faced compression ring, while the third is a slotted oil-control ring.

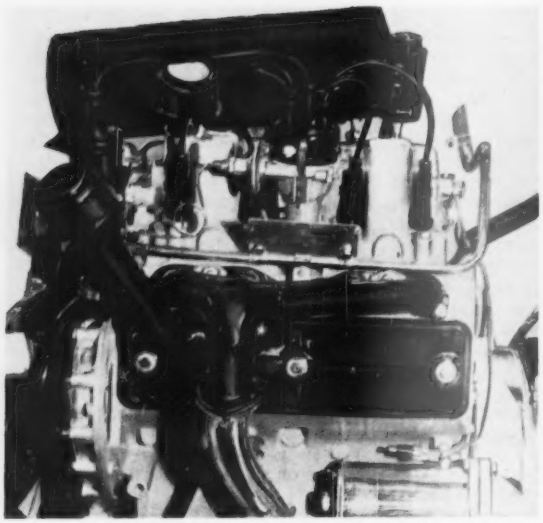
A $\frac{1}{4}$ in pitch, single-strand roller



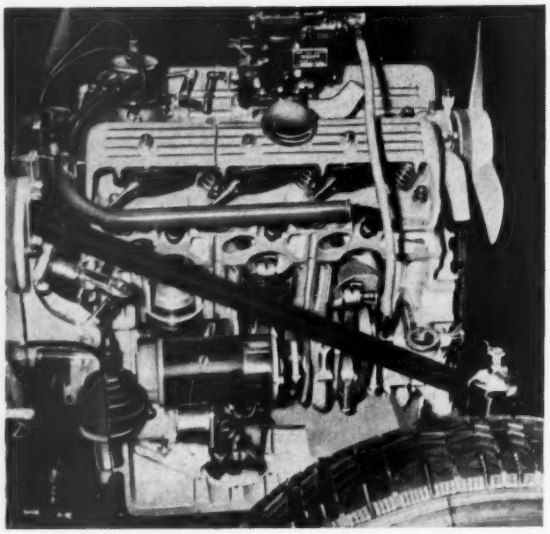
An integral inlet and exhaust manifold is employed on the Standard Eight



Aluminium rocker pedestals are fitted on the Standard Eight cylinder head



A wire-wool air filter is fitted in the combined breather and oil filler cap of the Rover 60



An unusual rocker arrangement is employed in the Lancia Aurelia

timing chain transmits the drive to the camshaft, and a spring-leaf type tensioner bears against the outer face of the chain. The half-speed wheel is so designed that it may be assembled with either face bearing against the camshaft, and the four holes for the bolts securing it are spaced in such a way that the timing adjustment obtainable is equivalent to ¼ tooth of the sprocket. Axial location is effected by a C-plate bolted to the front wall of the crankcase and engaging in a groove round the shaft.

The valve-operating gear is of conventional design. A rocker ratio of 1·5 : 1 has been adopted and the valve lift is ¼ in. The tappet clearance is 0·010 in and, to avoid excessive changes in clearance as between hot and cold conditions, aluminium rocker pedestals are employed. The valve timing is as follows: inlet opens 10 deg B.T.D.C. and closes 50 deg A.B.D.C., exhaust opens 50 deg B.B.D.C. and closes 10 deg A.T.D.C. The ignition timing in the static position is 10 deg B.T.D.C.

Siamesed inlet and separate exhaust ports are incorporated in the cast iron cylinder head. They are served by an integral exhaust and inlet manifold of cast iron, and the hot spot is exhaust heated. An unusual feature for such a small engine is a coolant distributor tube in the head. This tube directs water round the hot parts in the head, and the head casting adjacent to its rear end is shaped in such a manner as to deflect some of the water down into the block to give a positive coolant circulation round the cylinders. The jet tube arrangement is undoubtedly a good feature, and should prevent trouble from overheated valves and seats.

The lubrication system is of conventional design. A Hobourn-Eaton pump is bolted below the centre main bearing web at a position offset slightly from the central transverse plane. It is self-priming by virtue of the fact that both the inlet and outlet ports are positioned near the top of the casing. The relief valve blow-off pressure is 50-55 lb/in^2 at 2,500 r.p.m. A paper filter of the by-pass type is used.

New sports-car engines

A completely new British Motors Corporation engine is used in the new M.G. Magnette, ZA model. This four-cylinder unit has a swept volume of 1,489 cm^3, and the bore and stroke are 2⅜ in and 3½ in (73·025 mm and 89·0 mm) respectively. At 4,600 r.p.m. the power developed is 60 b.h.p., while the maximum b.m.e.p. and torque, which are obtained at 3,000 r.p.m., are 126·3 lb/in^2 and 76·1 lb-ft respectively. A compression ratio of 7·5 : 1 has been adopted.

The stroke : bore ratio is 1·22 : 1 and the connecting rod length : stroke ratio is 1·86 : 1. At maximum b.h.p., the mean piston speed is 2,680 ft/min. A specific output of 2·3 b.h.p/in^2 piston area is obtained. The dry weight of the engine together with its carburettors and air cleaner is 353 lb, and the power output per pound weight of the engine is 0·17 b.h.p. The gearbox weighs an additional 67 lb.

The unit is installed on Metalastik rubber-to-metal bonded sandwich mountings, a 40 deg vee-arrangement being employed at the front and a 70 deg vee at the rear. An engine installation angle of 3¼ deg from the horizontal has been adopted.

An integral cylinder block and crankcase unit is employed. The cylinder wall thickness is 0·203 in and the bores are fine honed. Three main journal bearings carry the crankshaft, and axial location is effected at the centre one, the end float permitted being 0·002-0·003 in. The thin-wall, steel-backed, white-metal main bearings are 2 in diameter by 1⅜ in long. Bearings of similar material are employed in the connecting rod big ends, but they are 1⅞ in diameter. The seal at the front of the crankshaft is a felt ring, while at the rear an oil return scroll and a thrower are employed. The flywheel which, with the ring gear, weighs 28¾ lb, is made of 18-ton cast iron and its overall diameter is 11·65 in.

The centre-to-centre length of each of the connecting rods is 6½ in, and the big end is split at an angle of 43 deg. Lateral location has been effected by shouldering the cap; and the rod, which is also shouldered, registers in it. The gudgeon pin is clamped in the rod and its diameter is 0·6869 to 0·6871 in. Aluminium alloy, split-skirt pistons are fitted. Three compression rings are employed, the top being of plain section and chromium-plated, while the other two are taper faced. Their face width is 0·0776 in. One slotted oil control ring with a face width of 0·1557 in is used.

A ⅜ in pitch, two-strand, Renold timing chain transmits the drive to the half-speed wheel. No tensioning device has been provided, nor is there any arrangement for fine adjustment of the timing. The camshaft is carried in three, steel-backed white-metal bushes. This will not only give a reduced rate of wear and consequently long trouble-free service but replacement, when it becomes necessary, will be relatively easy. Axial location is effected in the usual manner by a thrust plate at the front.

Push-rod operated, overhead valves are employed, and the rocker ratio is 1·426 : 1. Silchrome inlet valves are fitted and the throat diameter is 1⅝ in. The exhaust valves are of XB steel and the throat diameter is 1⅜ in. With a hot tappet clearance of 0·015 in, the inlet valve opens at 5 deg B.T.D.C. and closes at 45 deg A.B.D.C., while the exhaust opens at 40 deg B.B.D.C. and closes 10 deg A.T.D.C.

A cast iron cylinder head is employed and it is held down on a corrugated steel gasket by eleven $\frac{3}{8}$ in diameter studs. Heart-shaped combustion chambers are incorporated. The exhaust manifold is of cast iron, while the inlet manifold is of cast aluminium and the two S.U. horizontal carburettors, each with a $1\frac{1}{4}$ in diameter choke, are mounted on it. There is no hot spot.

A conventional rotor-type pump serves the coolant system of this unit, which does not incorporate a distributor tube in the cylinder head. A thermostat is fitted in the water outlet to the fin-and-tube radiator. In the lubrication system, a Hobourn-Eaton pump, with a fixed suction-type pick-up, draws oil through a gauze strainer in the sump the capacity of which is $6\frac{1}{2}$ pints. A by-pass oil filter, with an open bleed to the crankcase, is fitted. The relief valve blow-off pressure is 50 lb/in^2. A conventional vertical spindle and spiral gear arrangement from the camshaft drives the pump, which is situated below the crankshaft centre main bearing.

The M.G. TF Midget now has a more highly tuned power unit. It is, in fact, the Mark II engine formerly offered as an alternative in the TD model. The power output has been increased to 56 b.h.p. at 5,000 r.p.m. This has been done by raising the compression ratio from $7\frac{1}{4}$:1 to 8:1, and fitting twin S.U. carburettors with $1\frac{1}{2}$ in diameter chokes. In addition, the ports have been enlarged, the inlet throat diameter now being 31 mm and the exhaust throat diameter 29 mm. The valve head diameters are respectively 36 mm and 34 mm. Each valve is fitted with two springs and engine speeds up to 6,000 r.p.m. may be obtained without valve bounce.

Other details of the general specification of this four-cylinder 1,250 cm^3 power unit follow. At 3,500 r.p.m. the maximum b.m.e.p. of 125 lb/in^2 and the maximum torque of 63 lb-ft are developed. A brake specific fuel consumption of 0·56 pt/b.h.p/hr is obtained. The bore and stroke are 66·5 mm and 90 mm respectively. This gives a stroke: bore ratio of 1·352:1, and with a connecting rod centre-to-centre length of 178 mm, the connecting rod length: stroke ratio is 1·978:1. The mean piston speed at 5,000 r.p.m. is 2,940 ft/min. An output of 2·6 b.h.p/in^2 piston area is developed. The engine dry weight is 329 lb, so in terms of b.h.p. per pound, a figure of 0·17 is obtained.

An integral cylinder block and crankcase unit, in which the cylinder wall thickness is 5·5 mm, is employed and the cylinder bores are hone finished. Three main bearings are incorporated to carry the En 100 B/T crankshaft. The diameter of the journals is 52 mm while that of the crank pins is 45 mm. The main journal bearings are of M.G. manufacture. The B.S.1452 grade 12 cast iron flywheel weighs $23\frac{1}{2}$ lb and is 283·5 mm diameter. It carries an En 3A starter ring gear.

On the connecting rods, the bearing caps seat at 90 deg to the axis, so that close-fitting bolts may be used for lateral location. Glacier white-metal bearings are employed. The small end bore diameter is 18 mm (0·709 in) and the hollow gudgeon pin is clamped in the rod.

A $\frac{1}{2}$ in pitch Renold chain transmits the drive to the half-speed wheel, and the M.G. chain-tensioning device is employed. Axial location of the case-hardened, En 32 camshaft is effected by the usual thrust plate arrangement. Conventional push rods and valve operating gear actuate the overhead valves. The inlet valves are of En S27, while the exhaust valves are of XB steel, En 59. A valve lift of 0·326 has been adopted and the rocker ratio is 1·482:1. With the tappet clearance set at 0·017 in, the valve timing is as follows: inlet opens 5 deg B.T.D.C. and closes 45 deg A.B.D.C., exhaust opens 45 deg B.B.D.C. and closes 5 deg A.T.D.C. The static ignition timing is at top dead centre.

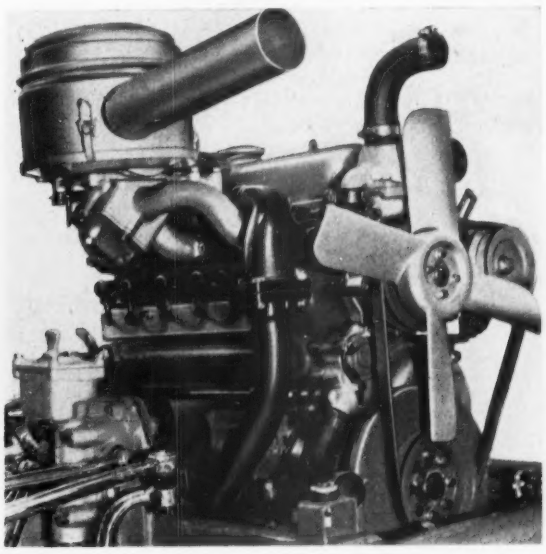
A B.S.1452 grade 10 cast iron cylinder head is held down on a copper and asbestos gasket by ten studs which are 10 mm diameter. The familiar inverted bath tub type of combustion chamber has been adopted and the inlet ports are siamesed. The exhaust and inlet manifolds are B.S.1452 grade 12. An exhaust-heated hot spot is incorporated.

In the new Riley Pathfinder, the 2·5-litre engine has been retained but in substantially improved form. The compression ratio has been increased from 6·8:1 to 7·25:1, and alterations have been made to the pistons, ports and inlet manifold. This has resulted in an increased power output of 110 b.h.p. at 4,500 r.p.m. At 3,000 r.p.m. the maximum torque of 142 lb-ft and the maximum b.m.e.p of 143·5 lb/in^2 are developed. The bore and stroke of the unit are 80·5 mm and 120 mm respectively.

From this specification, it can be seen that the stroke: bore ratio is 1·491:1, and the mean piston speed at maximum b.h.p. is 3,540 ft/min. The connecting rod centre-to-centre length is 8·625 in, so the connecting rod length: stroke ratio is 1·826:1. An engine dry weight of 589 lb is quoted and the output in terms of b.h.p/lb is 0·187. The b.h.p. developed per square inch piston area is 3·48, and the minimum brake specific fuel consumption is 0·476 pt/b.h.p/hr. Metalastik interleaved, or double-sandwich type, rubber-to-metal bonded units support the engine at the front, and at the rear



The B.M.W. engine has a breather inlet on the front of the rocker box and a pipe outlet towards the rear



A new feature of the B.M.W. is the water rail, in which is the oil cooler unit, on the side of the cylinder block

a Metaxentric bush is employed with its axis positioned transversely.

Liners are not employed in the integral cylinder block and crankcase unit. The cylinder wall thickness is about 0·2 in and the bores are hone finished. Three main bearings support the En 19-V9D crankshaft which is located at the rear main bearing. The diameter of the journals is 2·625 in and the bearings are of Riley manufacture. An En 5C steel flywheel is employed. Its overall diameter is 12½ in and it weighs 36¼ lb.

Steel connecting rods, to specification En 5C/R, are fitted. The bearing caps seat at an angle of 39 deg and lateral location is effected by close-fitting bolts. The crank pins are 2·3622 in diameter and a Glacier copper-lead shell is used in the rod half in conjunction with a babbitt shell of the same manufacture in the cap half. This arrangement has been adopted as a compromise to take advantage of the conformability and embeddability properties of the white-metal, while at the same time using the stronger material in the more heavily loaded area. A phosphor-bronze small end bush is employed, the specification being B.S.1400, PB1 C. The bearing internal diameter is 0·8661 in, and the gudgeon pin is of the fully floating type located by circlips in the piston bosses. Bricovmo low-expansion pistons with T-slotted skirts are employed. They carry two rectangular compression rings and two Maxigroove oil-control rings.

A Renold Auto-tensioner is employed with the ½ in pitch chain which transmits the drive to the En 32A camshaft. Axial location of the shaft is effected by means of a flange which bears against the front wall of the cylinder block and crankcase unit. The valves are actuated by conventional push-rod and rocker gear. Both the inlet and exhaust valves are of Silchrome valve steel to specification En 52 V24. The inlet throat diameter is 1·702 in and that of the exhaust is 1·476 in. Two springs are employed on each valve, and the valve lift is 0·378 in while the rocker ratio is 1·382 : 1. With the tappet clearance set at 0·01 in, the inlet valve opens at 12 deg B.T.D.C. and closes at 53 deg A.B.D.C., and the exhaust opens at 53 deg B.B.D.C. and closes 20 deg A.T.D.C. The static ignition timing is 5 deg B.T.D.C.

In the Bristol 404, the power unit is but little changed as compared with the 403. The main differences are that the compression ratio is 8·5 : 1, instead of 7·5 : 1 as in the earlier unit, and the engine now develops 105 b.h.p. at 5,000 r.p.m. To suit customers' requirements, the engine may be supplied with a high performance camshaft which gives an increased overlap. With this, compression ratio is the same, but the power developed is 125 b.h.p. at 5,500 r.p.m.

The standard valve timing is: inlet opens 15 deg B.T.D.C. and closes 65 deg A.B.D.C., while the exhaust valve opens 65 deg B.B.D.C. and closes 15 deg A.T.D.C. With the high performance camshaft, the timing is: inlet opens 40 deg B.T.D.C. and closes 80 deg A.B.D.C., and the exhaust opens 80 deg B.B.D.C. and closes 40 deg A.T.D.C. The main dimensions of this six-cylinder engine are as follows: bore 66 mm, stroke 96 mm and swept volume 1,971 cm³.

Other new engines

Two new Rover engines, the 60 and 90 models, have been introduced; so that with the 75 unit a range of three engines is now manufactured. The introduction of the six-cylinder 90 unit is in conformity with the recently developed trend towards providing the greater power : weight ratio which is demanded in certain overseas markets. On the other hand, the four-cylinder 60 model is intended to meet the conditions obtaining in countries where fuel costs are high and economy is of prime importance. The six-cylinder 75 engine forms a compromise between these two extremes. Although there is little difference, on a swept volume basis, between the 60 and 75 engines, the four-cylinder unit is positively tuned for economy, whereas the 75 is designed to give better performance and smoother running.

Basically, all three engines are similar, but in the 90 the cylinder axes are more widely spaced than in the 75, although the overall length of the unit has not been increased. The En 110 crankshaft has been made common to both units. It is hardened to 270-310 Brinell to suit the sintered lead-bronze bearings with a lead-tin overlay, which have been used in the larger engine so that the bearing lengths could be reduced and the rods accommodated within the same length of crank pin called for on the 75 unit, in which white-metal bearings are employed. Previously an En 100 crankshaft was employed in the 75 unit.

The main journal bearing lengths of the three engines are as follows:

	60	75	90
Front ..	1·5 in	1·577 in	1·25 in
Intermediate	1·75 in	1·25 in	1·125 in
Rear ..	1·5 in	1·64 in	1·5 in

On the 60 and 90, the big end bearings are 0·875 in long, and on the 75 their length is 1·178 in. On all three models the crankpin diameter is 1·875 in while the main journal diameters are 2 in in the 60, and 2·25 in in the other two units. The big end bearings are all split at 90 deg to the major axis of the rod, and at the small end, fully floating gudgeon pins are employed. Specially shaped crowns, to suit the F-head com-



The crankcase of the Mercedes-Benz diesel engine is common with that of the side-valve petrol unit



In the Mercedes-Benz diesel unit the injection pump is bolted to the side of the crankcase and to the timing cover

bustion chamber shape, are incorporated on the aluminium alloy pistons. On the 60 and 90 engines, two taper-faced, chromium-plated compression rings are fitted. The upper of the two oil control rings employed is stepped and the lower one is slotted. The top 1½ in of the cylinder bores of the 75 unit only are chromium flashed and in this engine, plain compression rings are fitted.

Four Mazac bearings support the camshaft and the well-proved Rover F-head and valve-operating gear is employed. The joint face of the aluminium alloy head is machined at an angle of 20 deg from the horizontal and the combustion chamber is formed in the cylinder block. With this arrangement, provision can be made for effective cooling of the exhaust valves and ports, and the inlet and exhaust valves can be made larger than when both are in the head. At the same time, turbulence may be easily induced. In all three engines, a coolant distributor tube is carried immediately below the exhaust valve ports and from it the water passes up into the head.

The main features, not already mentioned, of the specification are:

Rover 60: Four cylinders. Bore and stroke, 77·8 mm by 105 mm. Swept volume, 1,977 cm³. Compression ratio, 6·73 : 1. Power, 60 b.h.p. developed at 4,000 r.p.m. Maximum torque, 101 lb-ft at 2,000 r.p.m. Three-bearing crankshaft.

Rover 75: Six cylinders. Bore and stroke, 65·2 mm by 105 mm. Swept volume 2,103 cm³. Compression ratio, 6·73 : 1. Power, 75 b.h.p. at 4,200 r.p.m. Maximum torque 111 lb-ft at 2,500 r.p.m. Four-bearing crankshaft.

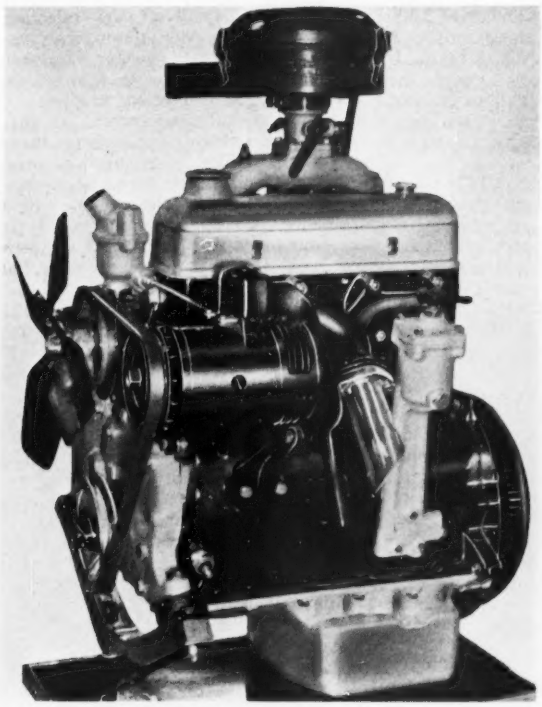
Rover 90: Six cylinders. Bore and stroke, 73·025 mm by 105 mm. Swept volume 2,638 cm³. Compression ratio, 6·73 : 1. Power, 90 b.h.p. developed at 4,500 r.p.m. Maximum torque, 130 lb-ft at 1,500 r.p.m. Four-bearing crankshaft.

Two new Daimler models have been introduced since the 1952 Motor Show. One is the standard Conquest saloon, while the other is the Conquest Roadster. It is of interest to compare the 2·5-litre engine of the saloon version with that of the Consort which had the same swept volume. The new unit develops 75 b.h.p. at 4,000 r.p.m., which is only slightly more than the 70 b.h.p. developed at 4,200 r.p.m. in the Consort. However, the interesting feature of the comparison is that this engine is 120 lb lighter than the earlier one. Part of this reduction in weight is accounted for by the adoption of a smaller stroke : bore ratio. This is in conformity with the general trend followed by most manufacturers since taxation in this country ceased to be based on the old R.A.C. horse-power formula. The weight reduction in the engine has also been accompanied by a parallel reduction on the remainder of the vehicle, with the object of increasing the power : weight ratio without increasing the power to such an extent as to over-stress the engine.

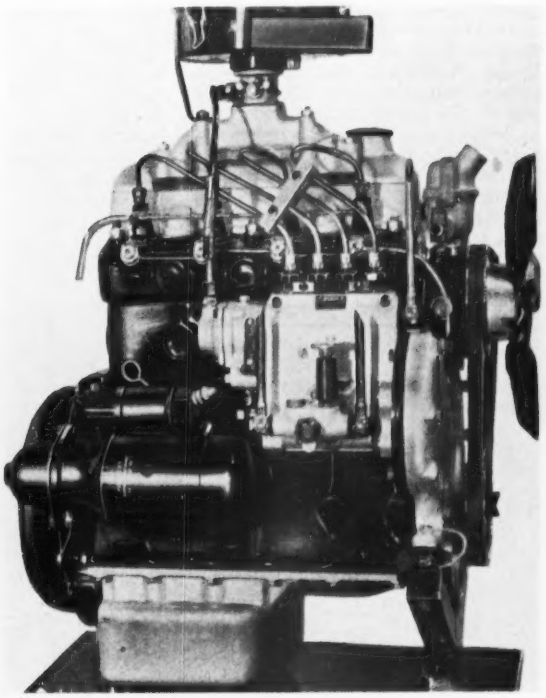
The specification of the standard power unit is as follows: Six cylinders. Bore 76·2 mm, and stroke 88·9 mm. Swept volume 2,433 cm³. Compression ratio 7 : 1. In the Conquest Roadster, the specification is mainly the same, but two S.U. horizontal carburettors are employed in conjunction with an aluminium cylinder head, instead of the cast iron one on the standard version. In addition, a high performance camshaft is incorporated, and the compression ratio is 7·75 : 1. As a result of these modifications, the power developed is increased to 92 b.h.p. at 4,000 r.p.m.

Several unconventional features are incorporated in the engine of the B.M.W.501. This unit has six cylinders and its bore and stroke are 66 mm and 96 mm respectively. The swept volume is 1,971 cm³, and the compression ratio is 6·8 : 1.

One of these unusual features is a heat exchanger for oil cooling. This exchanger is of tubular form and is carried in a water rail cast integrally on the right-hand side of the cylinder block and crankcase unit. The advantages of water cooling for oil are, of course, well known. Not only is the cooling adequate when the engine is running hot, but also an exchange of heat takes place between the water and the oil which is thus warmed more rapidly when starting from cold. The breather system is also somewhat unusual, although it has been used for many years on B.M.W. engines. A gauze-covered air inlet is incorporated in the front end of the rocker cover on top of which, towards the rear, is an adaptor for a large banjo connection from which a conventional breather pipe is extended down to a point near the base of the engine.



A small flywheel is employed on the diesel engine of the Borgward Hansa 1,800 car



On the Borgward Hansa engine, all injection pipes and heater leads are short

German diesel engines

Among the exhibits on the stand of Mercedes-Benz, the diesel-engined car and its power unit attracted considerable attention. The general specification of this unit is as follows: Four cylinders. Bore 75 mm and stroke 100 mm. Swept volume 1,767 cm³. Power developed, 40 b.h.p. at 3,200 r.p.m. Compression ratio 19:1. The overall dimensions are: length 27 in from the fan to the joint face for the bellhousing, width 21 in, height 26 in without air cooler. The flywheel is 11½ in diameter, but is of fairly heavy construction. A maximum speed of 60 m.p.h. is claimed for the vehicle and the overall fuel consumption is said to be 46 m.p.g.

The engine is basically the same as the 170VA and 170S petrol engines. All three have the same bore and stroke and they have a common crankcase casting. Although the petrol engines are of side-valve design, the diesel unit has push-rod and rocker actuated overhead valves carried vertically in-line in the head. The side-valve ports are blanked off by a plate bolted to the side of the integral cylinder block and crankcase casting and the push rods are passed through the side-valve guide housings. Apart from this, the valve gear is of conventional design and the camshaft arrangement is similar to that employed in the petrol engines. An unusual feature is the rocker cover joint washer. This is of U-section rubber and the lower edges of the cover fit tightly into the U, so that when the cover is removed, the washer comes away with it and is not damaged during subsequent servicing operations.

Combustion takes place initially in a spherical pre-combustion chamber in which is fitted a heater-plug for cold starting. A flanged discharge port is pressed from above into a hole in the base of the pre-combustion chamber, the lower part of which is machined in the head. The top portion of the chamber is a separate component pressed into the head and is held down by a ring nut which bears on its flanged upper end. This ring nut also accommodates the injector.

In most other respects, the engine is of conventional design. A three-bearing crankshaft is employed and axial location is effected at the centre bearing. The connecting rod big ends are split at right angles and the pistons are of the substantial proportions necessary for diesel units. Although separate liners are not fitted, the manufacturers claim that 95,000-125,000 miles without overhaul are not uncommon with these engines. Helical gears transmit the drive to the half-speed wheel and to the Bosch injection pump, and the usual triangulated vee-belt serves the dynamo, fan and water pump. The rear wall of the water pump rotor housing is formed integral with and well inside the front of the cylinder head, and the flanged nose piece, containing only the two widely spaced ball bearings and the spindle, is bolted to the front face of the head. This arrangement no doubt reduces the overall length of the engine.

An extremely compact diesel engine was shown on the Borgward stand. The overall length of this unit is 25½ in from the rear of the flywheel to the front of the fan, and its overall width is 25½ in. The height, measured between the base of the sump and the spigot flange that carries the oil bath air cleaner, is 30 in. A dry weight of 343 lb is quoted.

A car was available for trial runs, and a demonstration showed that the vibration felt inside the body was certainly no more than that experienced in comparable petrol-engined saloon cars; in other words, it was barely noticeable. Although, because of the note of the engine noise, there was no mistaking the fact that there was a diesel unit in front of the vehicle, it by no means made it unacceptable. In fact, the impression gained was rather that the noise was noticeable more because it was different from that normally experienced in a saloon car rather than because it was loud. The main difference between an engine of this type and a petrol unit is that under slow running conditions the diesel engine can be heard plainly on account of the diesel knock, whereas a petrol engine is generally extremely quiet under these conditions. However, when pulling normally, the diesel unit in the Borgward car made no more noise than a petrol engine.

The engine has four cylinders, and the bore and stroke are 78 mm and 92 mm respectively. A compression ratio of 19·8:1 has been adopted, and the swept volume is 1,758 cm³. The maximum power output is 42 b.h.p. at 3,400 r.p.m., while the maximum torque of 76 lb-ft is developed at 2,200 r.p.m. It is customary in Germany to quote the b.m.e.p. obtained at maximum cruising speed, rather than the maximum b.m.e.p., and the figure given is 91 lb/in² at 3,200 r.p.m.

The stroke: bore ratio is 1·81:1, and the connecting rod length: stroke ratio is 1·74:1. At 3,400 r.p.m., when maximum b.h.p. is developed, the mean piston speed is 2,060 ft/min. The specific output figures are 1·42 b.h.p/in² piston area, 23·9 b.h.p/litre and 0·123 b.h.p/lb weight. It is stated that the overall fuel consumption is 50 m.p.g. or more.

The engine is mounted on a conventional vee-arrangement of rubber sandwich units at the front, while at the rear, a rubber sandwich is positioned horizontally under the gearbox rear extension. The lower metal component of the rear sandwich unit is of channel section in which is contained the rubber and the upper plate. Its vertical flanges give positive fore and aft location. A conventional integral cylinder block and crankcase is used and, despite the fact that separate liners are not fitted, it is claimed that 100,000 miles may be completed before a rebore becomes necessary.

A three-bearing crankshaft is employed. The diameter of the main journals is 55 mm and that of the crank pins 50 mm. Steel-backed, lead-bronze bearings are used throughout. At the front, the nut retaining the pulley and timing drive gear incorporates dogs for a cranking handle but this is for making timing adjustments only, and is not for hand starting. An unusual feature for a diesel engine is the light flywheel, which is only 11 in diameter and which appears to be no heavier than that employed on most petrol engines of its size. As a result, gear changing should be easier and the torque fluctuation reactions on the mountings should be lighter than would be the case if a larger flywheel had been employed.

The connecting rods have a centre-to-centre length of 6·3 in and light alloy piston with plain skirts are employed. Each piston carries three compression rings and two oil-control rings. The top oil-control ring, which is above the gudgeon pin, is of the taper-faced type while the other, in the base of the skirt, is a conventional slotted component.

Helical gears drive the camshaft and injection pump. The valve timing is as follows: Inlet opens 10 deg B.T.D.C. and closes 56 deg A.B.D.C., while the exhaust opens 52 deg B.B.D.C. and closes 14 deg A.T.D.C. In the cylinder head, swirl chambers similar to the Ricardo Comet type are employed. Each is held down by a ring nut which also forms an adaptor which carries the injector. For servicing purposes, the ring nut may be taken out and an extractor screwed into its place to remove the chamber.

A noteworthy feature of this engine is the neat layout of the injection system. The injection pump, injectors and the leads for the heater-plugs for cold starting are all close together on the right-hand side of the engine.

Bosch injection equipment is employed and servicing facilities for these units are available in this country. The injection pump is pneumatically governed, and the injectors work at a pressure of 105 atmospheres. It is recommended that from ½ to ¼ per cent of lubricating oil is mixed with the fuel. This increases the life of the injection pump components. The inlet porting arrangements are somewhat unusual in that the two ports, each of which serves two cylinders, are carried vertically up through the bolted-on, cast aluminium rocker box. A separate cast aluminium cover is bolted down on top of the box.

There are several unusual features in the coolant system. The rotor type pump is lubricated by means of a screw-on grease cap. A radiator blind is employed and a thermometer in the header tank registers at the instrument panel. The total water capacity of the coolant system is 13½ pints. In the lubrication system an edge-separation type filter is employed and it incorporates a manually operated rotary cleaner. An oil pressure warning light is fitted instead of an oil gauge, and the sump capacity is 10½ pints.

CARBURATION AND INDUCTION SYSTEMS

Wider Application of the Thermostatically Controlled Hot-spot

THE lower bonnet line has undoubtedly come to stay for some time, and continues to create difficulty for the engine designer in finding room for the carburation system. The increasing popularity of the V-eight engine in the U.S.A. renders the American aspect of the problem somewhat less severe than with European design, which is still mainly concerned with in-line engines. Nevertheless, although the conventional system of V-eight carburation requires less head-room owing to the downdraught carburettor being placed rather low in the middle of the vee, the majority of American downdraught carburettors exhibited showed great ingenuity in the attempt to decrease their height. Apart from the Nash Ambassador, which was equipped with a Carter horizontal carburettor of the triple-venturi pattern, this type of instrument was conspicuously absent on American engines. It is possible that but for the popularity of the V-eight power unit, the horizontal carburettor would have had a greater following in the United States, despite the improved breathing characteristics of the downdraught type, owing to the pressure of stylists for the low bonnet line.

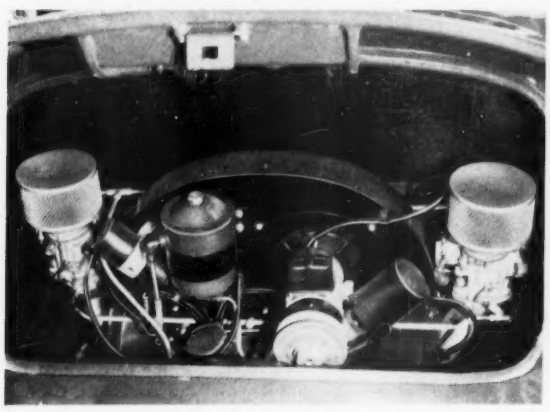
It was noticeable that the quantity-produced cars of British and Continental firms were almost exclusively equipped with downdraught carburettors. The exception was the Nuffield Organization, which on Morris, Wolseley and M.G. cars continues to employ the horizontal S.U. carburettor. A number of the smaller concerns, particularly those producing sports cars, exhibited models fitted with horizontal carburettors. Again, this is possibly due to a low bonnet and consequent lack of space.

As in previous years, the open-choke type of carburettor was by far the most widely used. Constant-vacuum instruments were fitted to a number of British cars exhibited, but without exception the American and Continental cars were equipped with open-choke models. Automatic economizer systems were almost universal on open-choke carburettors of 36 mm throttle bore and over. These were operated either by engine depression or by interconnection with the throttle spindle. Some provided a lean part-throttle mixture with automatic enrichment for full throttle. Others delivered maximum-power mixture on full throttle with a leaning-out device for part throttle by bleeding extra air into the emulsion system. All such economizer carburettors incorporated an acceleration pump, again operated either by engine depression or by the throttle interconnection.

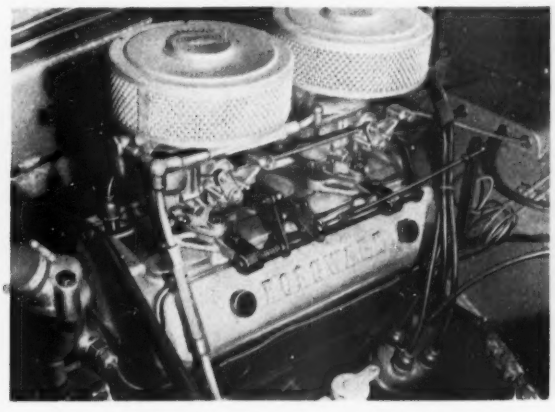
Cold-starting devices varied a good deal. Almost every American car exhibited was equipped with a version of the automatic choke. This assembly provides the mixture enrichment necessary for cold starting at the very low temperatures prevailing during North American and Canadian winters, together with automatic and gradual decrease in mixture strength in proportion to the warming-up of the engine. When appropriate running temperature is attained, the mixture strength is returned to normal. All versions of the automatic choke function on the principle of an offset-mounted strangler valve, connected to a bi-metal thermostat spring which is subjected to engine temperature. Incorporated also is an automatic fast-idle system, which ensures that when cold the engine is running sufficiently fast to avoid stalling. A number of British cars were equipped with a version of the automatic choke, among which were Rolls-Royce, Bentley, Humber, Sunbeam-Talbot, and the Austin Princess. Others, including Jaguar and Riley, were fitted with a small auxiliary carburettor brought into action by a thermostat. In general, most British cars were fitted with manual strangler systems, with linked fast-idle. Most of the Continental cars, on the other hand, were equipped with hand-operated auxiliary starter carburettors, as also were some British makes.

Introduced for the first time at the Motor Show last year, the four-barrel, fully-automatic carburettor, designed especially for V-eight engines, has evidently justified itself and seems now to be firmly established. Operating on the open-choke principle, these instruments were first produced by Bendix, Stromberg, and Carter. Similar carburettors are now produced by Holley and Rochester, and examples of each make were exhibited. The object of this design is to provide the maximum power from engines of V-eight layout while maintaining tractability at low speeds. Arranged in pairs side-by-side, the four barrels are fed by a single float chamber which almost surrounds the four air passages. Each pair of barrels has its own spindle fitted with two throttle valves. The two spindles are arranged at right angles to the engine crankshaft, and are linked together so that one pair of throttle valves opens later than the other pair. An additional pair of throttle valves, located under the main throttles of the secondary pair of barrels, are subject to engine depression. Such an arrangement inevitably introduces greater complication, and the service of such instruments must fall still more into the hands of the highly trained specialist.

The fitting of air silencers as standard equipment, together with oil-bath air cleaners on vehicles for export to areas where dusty conditions obtain, is



The Porsche 1500 Super. The carburettors are larger than on the standard model

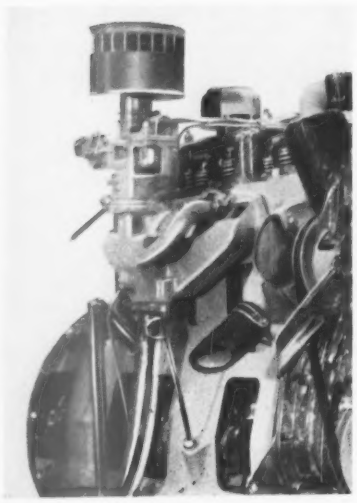


Neat twin downdraught installation on the Borgward Hansa 1500

now common practice. Much ingenuity was shown on some of the American exhibits, where the air silencer was built around the carburettor. A somewhat striking feature of some of the American installations was the great size of the air silencers, which often incorporated an oil-bath air cleaner. An attractive feature of some of the American air silencer systems was the quick-release screw clamp to facilitate removal of the silencer. In most instances the supporting stays provided to hold the air silencer were adequate. Four-cylinder engines in particular require stout supporting stays for the silencer, since the zinc-based metal employed for the construction of carburettors cannot be expected to withstand the stresses imposed by the rocking mass of the air silencer. While most of the American models bore combined air silencers and oil-bath air cleaners, a number of British manufacturers exhibited examples of separate air silencer and oil-bath cleaner installations. This is doubtless the result of supplying an air silencer only for home deliveries, but with an attached oil-bath air cleaner for specific exports.

Despite the increased volatility of the present-day fuels, and the resulting hazard of vapour formation in the fuel system, the great majority of cars exhibited retained the mechanically operated diaphragm pump, attached to the side of the crankcase and operated by a lever running on a cam on the engine camshaft. All the American and most of the British exhibits were so equipped. The electrically operated fuel pump was employed by certain British manufacturers and in some cases, notably on Rolls-Royce, Bentley, and Jaguar, it was mounted on the chassis frame and remote from engine heat. It is surprising that some such system is not more widely employed.

Induction systems continue to provide the usual widely differing ideas, both in shape and in the methods of applying the necessary heat to assist vaporization. A noticeable feature of

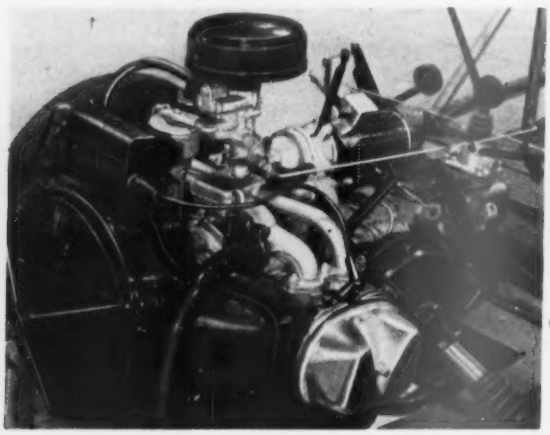


The new Standard Eight carburettor and induction system

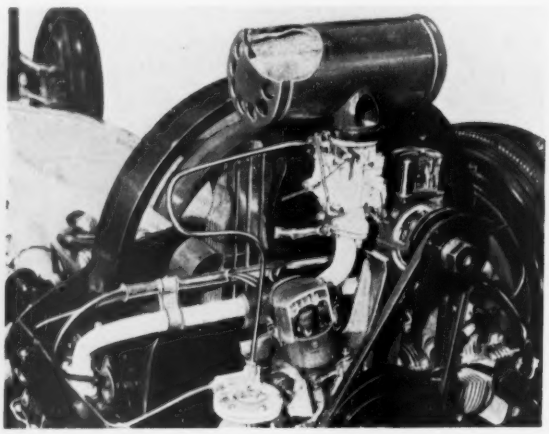
recent years is the greater interest shown by British engine designers in the thermostatically controlled hot-spot. An almost universal item of American design, the thermostatically controlled heat valve has until recently been very largely ignored by manufacturers in this country, although Vauxhall has employed this type of hot-spot since before the war. The Standard concern began to use it last year, the Rootes group introduced it on the Hillman Minx this year, and a version of this form of heat control was included in the design of the new Ford Anglia and Prefect models exhibited.

While individual application may vary slightly, the device consists in essentials of a sheet-metal plate valve mounted on a spindle in the lower part of the exhaust manifold. Attached to one protruding end of the spindle is a bi-metal thermostat spring, the outer end of which is anchored to the manifold casting. The thermostat spring is so arranged that when the engine is cold, the plate valve is held in a position to direct hot exhaust gases up and around a jacket surrounding the junction of the induction riser and gallery tract. When the engine is hot, the thermostat spring will pick up heat from the exhaust manifold, and the tension of the spring will be released, so permitting the plate valve to move to the opposite position, where it will direct the exhaust gases away from the induction junction and into the exhaust pipe. Most installations incorporate a counter-weight on the end of the valve spindle remote from the thermostat spring, to assist the opening of the valve.

Porsche exhibited the 1500 Super version of the air-cooled flat-four engine, which was absent from the Motor Show last year. As might be expected from its outstanding performance in the Alpine Rally, this model attracted a good deal of attention. Carburation on this type of engine is conventional for high power requirements. Two separate downdraught carburettors, larger than those on the standard model, are employed, each feeding the two cylinders in each bank. Two individual inlet ports are arranged on the upper side of each cylinder head, and a short, bifurcated induction manifold of cast aluminium carries the carburettor. Apart from a small outward curve the manifolds are almost vertical, so the mixture from the carburettors has a free downward path directly into the combustion chambers, a very satisfactory condition for high power output. This downdraught action of the mixture is probably the reason why the induction manifolds are unheated, although when cold some precipitation might be expected on the fork of the two branches and the point where the tracts curve inwards. Being an air-cooled engine, however, the cylinder heads doubtless warm up quickly. A long balance pipe connects the risers of the two induction manifolds. The two large downdraught Solex carburettors are equipped with the Solex starter-valve system and



Carburation system on the Citroen 2 C.V. Note the fabricated induction and exhaust system



The Volkswagen induction system. The small hot-spot jacket behind the ignition distributor is exhaust heated

diaphragm accelerating pumps operated mechanically by interconnection with the throttle levers. Fuel supply is by a mechanically operated fuel pump on the left rear of the engine casing and a separate petrol filter is placed between the pump and the fuel pipe feeding the carburettors.

Chief interest among the horizontally opposed twin-cylinder engines was the Citroen 2 CV. This remarkable little engine is served by a small single downdraught carburettor, feeding a long induction pipe leading to an inlet port on the top of each cylinder head. The manifold is fabricated of sheet steel and cannot be more than about ¼ in. diameter. A hot-spot jacket built round the riser and gallery junction is fed with hot exhaust gases by the main exhaust pipe of the right-hand cylinder. This pipe leads from the cylinder head, into the hot-spot jacket, from which it emerges, at the other side of the jacket, to join the exhaust pipe from the left-hand cylinder head. At the junction a pipe leads off forward and turns down in front of the engine and continues underneath to the exhaust silencer located across the frame to the rear of the engine. The cross-sectional area of the exhaust manifold is about twice that of the induction manifold. An interesting item is the provision made to prevent icing of the carburettor starter system under ice-forming conditions. A metal shield is arranged around the right-hand side of the exhaust manifold, close to the hot-spot. From here a small-diameter pipe is taken up into the air intake just below the air cleaner, which fits on top of the carburettor intake. Fuel supply is by a mechanical pump, mounted on the right front of the engine, and the petrol pipe from the pump to the carburettor is of synthetic rubber, a feature rather popular on Continental engines.

Somewhat similar is the carburation system of the four-cylinder Volkswagen engine. Here again a single downdraught Solex carburettor is employed, mounted on top of a very long unheated riser, which drops to join the long gallery pipe leading to the siamesed inlet ports of each cylinder head. An exhaust-heated jacket surrounds the junction, the jacket being fed by small diameter pipes from each exhaust branch. Individual exhaust branches from each of the four cylinders are connected directly to the exhaust silencer, which is placed to the rear of the engine and across the frame.

A newcomer among the Continental contingent, Borgward exhibited the Hansa 1500 model. Two downdraught Solex carburettors are fitted to the top of the cylinder head, each carburettor supplying downdraught siamesed inlet ports. Separate air silencers are fitted to each carburettor, and the whole installation is neatly arranged.

A model long awaited with considerable interest, the new Standard Eight, provides an example of compact induction design on conventional lines. A small downdraught Solex carburettor supplies mixture to a two port branch induction tract, each branch of which feeds two cylinders through siamesed inlet ports in the cylinder head. The induction manifold of iron is cast integrally with the four port branch exhaust manifold below, so that a generous hot-spot is provided to heat the mixture. From the cylinder head the induction port branches merge into the gallery tract in a gentle curve and with a downward slope, the lowest point being the riser and gallery junction. At this spot an induction drain pipe is fitted. By dropping both the induction and exhaust branches downwards from the cylinder head a riser of reasonable height is obtained, a useful item in these days of low bonnets and consequent lack of headroom. The arrangement of the exhaust manifold is also conventional, the exhaust down pipe being taken from the middle of the manifold. Attached to the top of the carburettor is a vertical air silencer of cylindrical shape, there being an unusual amount of under-bonnet space on this vehicle. Fuel supply is by means of an A.C. mechanical pump located on the left-hand side of the crankcase.

Another newcomer in the British four-cylinder range is the new Ford engine, which forms the power unit for both the new Anglia and Prefect models. While the side-valve design has been retained the carburation system is entirely different from the previous Ford models. A most striking innovation on these low-priced cars is the thermostatically controlled hot-spot, an item which is usually associated with vehicles in the medium-price range. Mounted on the left-hand side of the engine, the induction and exhaust manifolds are arranged one above the other in the conventional form, induction being uppermost. A downdraught Solex carburettor delivers mixture to a two port branch induction gallery of square section, the branches of which turn at a sharp right angle and drop steeply to the inlet ports in the cylinder block. Of cast iron, the induction manifold is bolted to the exhaust manifold at the centre, where the hot-spot system is situated. Following common practice with this device, the junction of induction riser and gallery tract is surrounded by a jacket, through which exhaust gases are circulated when the engine is cold. The four port branch exhaust manifold has its off-take in the centre, above which is the housing for the offset-mounted hot-spot plate valve, the spindle being arranged parallel with the crankshaft. Attached to the rear end of the valve spindle is the inner end of the bi-metal thermostat spring, the outer end being anchored to a pin on the manifold casting. The usual counter-weight is fixed to the front end of the spindle.

Introduced some months ago, the induction system of the Hillman Minx now incorporates a thermostatically controlled hot-spot for heating the mixture. The system is arranged on accepted lines as already described. As with the previous Minx models, the mixture is fed by a downdraught starter-type Solex carburettor, and a heat insulating gasket about ⅛ in thick is fitted between the carburettor and the induction manifold flange. Of cast



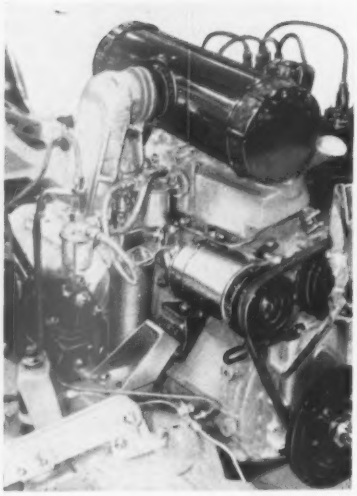
The Ford Anglia with the new induction system and thermostatically-controlled hot-spot



Another convert to the thermostatically-controlled hot-spot. The Hillman Minx carburation system

iron, the induction system is of the two port branch type with siamesed inlet ports. The tract is approximately square in cross section, and leads from the riser junction to the cylinder-block ports in a curve of rather greater radius than on the previous models. Affixed to one of the front studs of the hot-spot casting is a metal stay carrying a pad, against which the counter-weight of the heat valve abuts when in the cold position. No change has been made to the A.C. mechanical fuel pump, which, as before, is located on the right-hand front of the crankcase. Fitted directly on the top of the carburettor air intake is an A.C. T-type air silencer, with the air opening at the front.

Into a somewhat different category comes the new Rover 60 four-cylinder engine. Like the existing 75 model, the 60 has overhead inlet valves and side exhaust valves, the top of the cylinder block being machined at an angle of about 20 deg from the horizontal so that the combustion space is triangular in shape when viewed from the front or rear. Cast integrally with the cylinder head is the induction tract, which runs fore and aft on the right-hand side of the engine, and is surrounded with a jacket through which coolant from the cylinder head is circulated. The gallery tract is ∩-shaped so providing a flat floor to assist evaporation of the liquid fuel. From the gallery four port branches lead to the individual inlet ports, the inlet valves themselves being inclined some 20 deg from the vertical, in the direction of the induction side. Mixture is supplied by a horizontal S.U. carburettor bolted to the side of the cylinder head at a point in the middle of the induction gallery. An A.C. T-type air silencer is mounted above the induction portion of the head casting. The four port branch exhaust manifold is located on the opposite side of the engine. A commendable feature of the exhaust systems of the new Rover models is the method of making the various joints leakproof. The joints are of the cup-and-cone pattern, each being secured by three bolts spaced equidistantly apart.



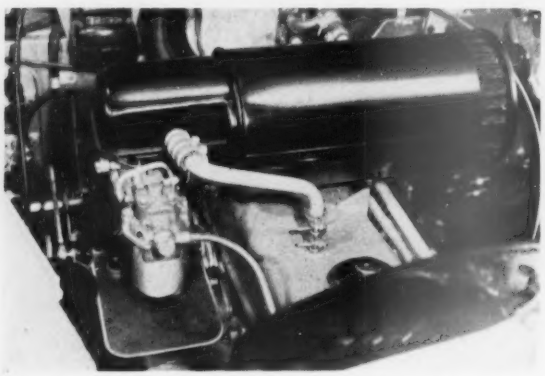
Cast within the cylinder head, the induction tract on the Rover 60 is coolant heated

Daimler designers have long favoured the six port induction system on their six-cylinder engines, and the new Conquest model incorporates this feature. Both induction and exhaust manifolds are arranged on the right-hand side of the engine, the induction being above the exhaust. Such a layout is usually associated with an exhaust-heated hot-spot but, following long-established Daimler practice, water heating is employed. The aluminium induction manifold casting is on the lines of the straight-rake pattern, the main gallery tract and ports being of circular section. A water jacket surrounds the gallery for the whole of its length, and although the tract is circular, the jacket of the casting is D-shaped in cross section, with the flat vertical wall facing the cylinder head.

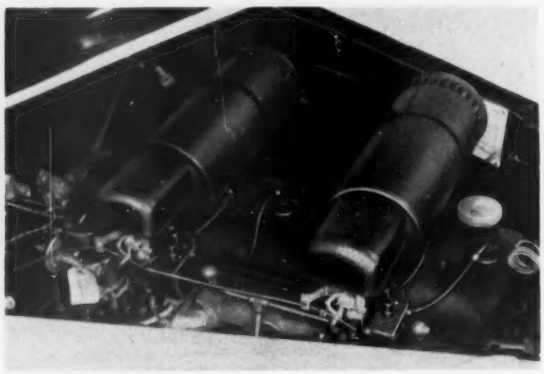
There are various arrangements of the spacing of a six-port system, and on the Conquest the outer ports are paired while the inner two are also close together. In order, however, to avoid these two branches being too close to the carburettor riser, they diverge sharply from the cylinder head at an angle of about 45 deg, and so enter the main induction gallery some inches on each side of the riser orifice. The other two pairs of branches are at right angles to the main gallery. Also of six-port design is the exhaust manifold. Here the two outermost ports are single ones, while the others are in pairs, located between the induction branches of cylinders number 2 and 3, and 4 and 5.

Mixture is supplied by a Zenith downdraught carburettor with suction-operated air-bleed economizer and accelerating pump, and with a strangler and linked fast-idle for cold starting. An A.C. air silencer of the L-type is arranged across the top of the rocker cover, from which a breather pipe is taken into the intake elbow of the air silencer. The A.C. mechanical fuel pump is on the left side of the engine, away from the exhaust manifolds. This is a good feature as the pump cannot pick up heat from the exhaust, but the fuel pipe, which runs from the fuel pump and round the front of the engine to the carburettor, is clamped to the water thermostat housing. It would seem that some heat could be transmitted to the fuel line at that point. On the Daimler Conquest Roadster a similar system is employed, but carburation is by twin S.U. instruments.

Little alteration has been made to the existing Rover 75 model which, as before, is fitted with two horizontal S.U. carburettors. In the case of the new 90 model, however, a single horizontal S.U. carburettor is employed. As on the 60 and 75 models, the induction system is cast within the cylinder head on the right-hand side and is coolant-jacketed for heating the mixture. In this instance, however, only the lower portion of the induction tract is heated, but an extension of the jacket is carried round the front of the tract to counteract the cooling effect of the fan, a point too often overlooked. The horizontal S.U. carburettor is fitted in the conventional position to feed into the middle of the induction gallery tract and is connected with the long cylinder Vokes air silencer above by means of a casting of rectangular section. Mounted along the right-hand top of the cylinder head and parallel



On the Daimler Conquest the downdraught carburettor supplies a six-port tract



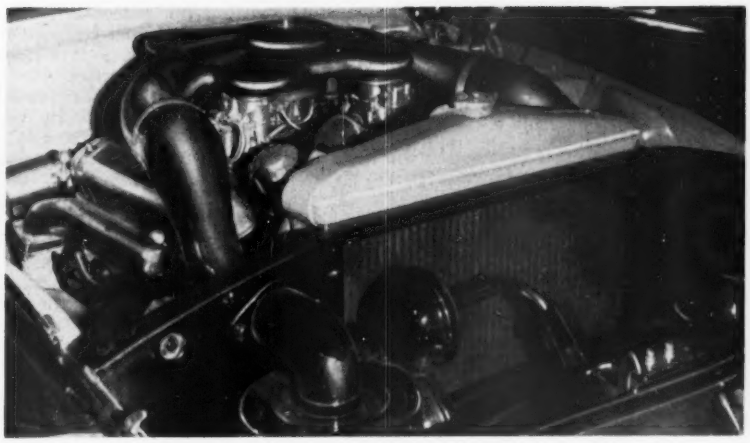
Twin downdraught installation on the new Armstrong Siddeley Sapphire

with the crankshaft, the air intake orifice of the Vokes air silencer is to the front. In common with the other Rover models, fuel supply is by an S.U. electric fuel pump.

Arranged on the left-hand side of the engine, the six port branch exhaust manifold has its off-take in the middle, from which the down pipe leads back to the twin exhaust silencer system. The two circular section silencers are placed in series, the first one located in the middle of the chassis, between the two main cross members.

One of the high lights of the Motor Show last year was the new Armstrong Siddeley Sapphire saloon, a large motor car with a high-performance 3·4-litre engine. Despite the size and weight of the car, this high performance was obtained with a single downdraught Stromberg carburettor of only 36 mm bore. This year a new model was exhibited, this time with a twin downdraught carburettor installation.

The same make and size of carburettor is employed, but in this instance the automatic economizer system is mechanically operated, instead of the suction-controlled device used on the single carburettor version. Like the single carburettor model, the main induction gallery is cored in the cylinder head, the six individual inlet ports branching out to feed each inlet valve of the hemispherical combustion chambers. As before, a detachable blanking plate divides the main gallery, and a drilled hole in the plate forms the balance orifice between the halves of the tract, each of which feeds three inlet valve ports. Instead of the four-port external induction manifold employed with the single carburettor, where two manifold port branches feed into each half of the gallery tract, two separate manifolds are now used. These take the form of two short curved castings, each with a central riser to which the downdraught carburettor is attached. The manifold tracts are of circular cross section, the outlets aligning with the four ports in the cylinder head which feed the internal gallery. This arrangement of a two-port feed into a gallery which in turn supplies three inlet valves is unusual, but it is most successful with the single carburettor version, a fact which is doubtless being exploited with the twin carburettor installation.

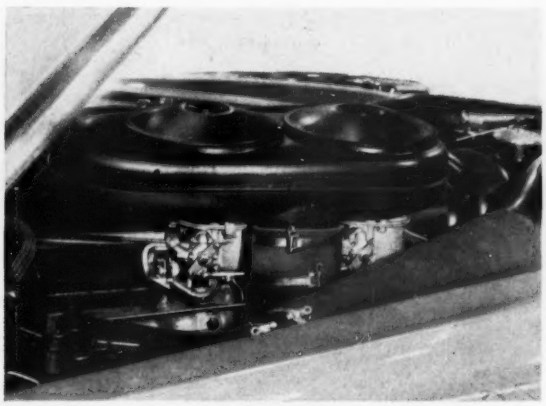


The Lincoln X-100 experimental car has one four-branch and four twin-branch downdraught carburettors which come into action progressively

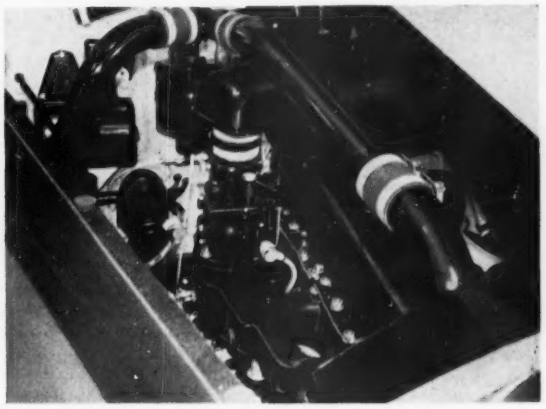
The twin induction manifolds are of cast aluminium and are jacketed for coolant heating over most of the length. Hot coolant from the cylinder head is fed direct into each jacket through ports in the head, the outlet being by way of a copper tube about ½ in diameter. The tube connects the rear manifold with the front one, and the return to the coolant pump is arranged by another copper pipe which leads from the forward end of the front manifold to the pump. Each induction manifold has its separate drain tube, with a non-return ball valve at the bottom of each tube. The downdraught carburettors are equipped with automatic economizer systems ensuring lean part-throttle mixtures for economical cruising, together with mechanical accelerating pumps. Both carburettors incorporate a hand-operated strangler system with linked fast-idle, the controls of both carburettors being linked together to a common operating cable. Instead of the pull-push arrangement usually employed for hand-operated stranglers a small lever is used. This is located on the left-hand side of the facia and works in a quadrant. The scheme is neat and the adjustment of mixture strength on warm-up is easily effected.

The arrangement of air silencers for twin carburettor installations is becoming something of a problem owing to the lowering of the bonnet line. In this instance, however, there is room for two separate A.C. air silencers of the end-feed pattern mounted across the engine. The whole arrangement of this twin carburettor version is neat and workmanlike. As before, the A.C. mechanical fuel pump is located on the righ-hand side of the engine, towards the front.

B.M.W. exhibited a somewhat unusual induction system on the type 501 two-litre engine. A Solex dual downdraught carburettor is employed, but instead of feeding into two separate induction riser ducts in the usual manner the two throttle barrels supply



The Mercedes-Benz 300 twin carburettor system. Each induction manifold has its own thermostatically-controlled hot-spot



Induction system, carburettor and automatic choke on the Rolls-Royce Silver Dawn

a common riser duct of rectangular shape with rounded ends. A three-port induction system is employed, feeding siamesed inlet ports. The two outer branches are taken from the well of the riser in the usual manner, but the centre branch is taken from a point remote from the other two, and at the opposite end of the rectangular riser and close to the engine. The floor of the riser is brought up to form a wall, doubtless to prevent the centre port branch from running over-rich. A jacket is formed round the riser and gallery junction but there is no exhaust gas flow through it. An extension of the induction casting is bolted to the upper face of the exhaust manifold, so providing the necessary hot-spot. It would appear that the original design was for an exhaust-heated jacket, the use of which has since been discontinued. An excellent feature of the installation is the arrangement of the Hann air silencer. This encloses the carburettor completely and is secured by three quick-action clips, which pull the casing of the silencer down to seal on a ring in the bottom portion of the silencer which is fitted between the carburettor and riser flanges. When the top casing is removed, the carburettor is fully accessible.

Mercedes-Benz exhibited a neat twin downdraught carburettor installation with the unusual feature of twin thermostatically controlled hot-spots. Two single downdraught Solex carburettors are employed, each feeding a separate two port branch induction manifold. The carburettors are fairly close together, so that the induction tracts from each riser lead fore-and-aft respectively before turning inwards towards the cylinder head. Of circular section, the tracts curve in to the inlet ports, the inner branch feeding siamesed valve ports. Each riser is jacketed for exhaust heat, the underside of the induction casting being bolted to the exhaust manifold, where there is a thermostatically controlled plate valve of the conventional pattern, together with thermostat springs and counterweights. Aluminium heat-shield plates are fitted between the carburettors and the induction manifolds. A single air silencer completely covers both carburettors, a very neat and clean looking arrangement.

On the 300 S model, three downdraught carburettors are used. In this case each carburettor is bolted to a "Y" shaped induction piece, which in turn is bolted to a tall extension on the exhaust manifold, so forming an exhaust-heated hot-spot, but thermostatically controlled plate valves are not used.

Now available for the home market, the Rolls-Royce Silver Dawn is equipped with the same power unit as that employed on the Silver Wraith model. The single downdraught Zenith - Stromberg carburettor is retained, complete with automatic choke, suction - operated economizer system and mechanical accelerating pump. The induction system is on the right-hand side of the engine, with the exhaust on the opposite side. In this arrangement the four port branch induction system has the two inner ports feeding siamesed valve ports and the two outer branches supplying individually cylinders 1 and 6. The central portion of the manifold casting is jacketed for hot coolant, and although the engine is mounted on the chassis with a noticeable transmission angle, the whole length of the induction gallery tract is arranged to be parallel with the road. This installation is of interest because it is one of the very few examples of the automatic choke using coolant heat to operate the thermostat unit. The housing containing the bi-metal thermostat spring is sunk into a well in the coolant jacket, and from the external lever of the thermostat device a rod leads up to the lever on the end of the strangler spindle. Like all versions of the automatic choke, the assembly contains the vacuum-kick arrangement for opening the strangler automatically as soon as the engine fires, together with automatic fast-idle to prevent stalling when cool. An air silencer of the "L" type lies across the top of the engine. Fuel supply is by an S.U. electrical fuel pump located low down on the chassis, a most commendable arrangement with the view of obviating vapour troubles.

On the new 100 m.p.h. Jenson Intercepter the power unit employed is similar to that of the Austin Princess. Arranged on the left-hand side of the engine, the induction and exhaust manifolds are located in the conventional manner, the induction over the exhaust. The three port branch induction manifold is of round section, and the two manifold castings are bolted together in the middle, to form a hot-spot. From the riser the port branches rise towards the cylinder head, and a metal plate is arranged round the branch bend of the front port to shield it from the cool draught of the fan. Mixture is supplied by a downdraught Zenith-Stromberg carburettor, with automatic economizer and accelerating pump. Also incorporated in the scheme is the automatic choke, the thermostat unit of which is located in a recess cast in the exhaust manifold below the hot spot. An A.C. air silencer of the "L" type is arranged with its air opening to the rear of the engine compartment.

Although basically similar to the V-eight engine exhibited at the last Motor Show, the power unit of the Studebaker Commander bears a number of modifications, chief among which is the carburation system. The induction system follows the general lines of the design that has become conventional for this type of engine. A dual downdraught Bendix Stromberg carburettor, mounted with the throttle spindle at right angles to the crankshaft, supplies four cylinders from each throttle barrel. The induction casting bridges the vee and contains all the induction tracts, as well as the gas tract for the exhaust-heated hot-spot. Each throttle barrel feeds the two inner cylinders on the bank nearest to it, and the two outer cylinders on the opposite bank. The tracts thus cross one another and one riser is of necessity longer than the other by the depth of the upper tract. Although the engine is fitted on the chassis with a pronounced transmission angle the carburettor is mounted in a vertical position, so that there is no initial tilting



The new Jenson Intercepter. The downdraught carburettor is fitted with an automatic choke and supplies a three-port induction tract



A horizontal carburettor, equipped with an automatic choke, is now fitted to the Nash Ambassador

of the float chamber. The exhaust-heated hot-spot is arranged under the junction of the risers. Exhaust gas flows into it from the left-hand side of the engine, and away from it to the right-hand side of the engine by way of cross galleries. A thermostatically controlled plate valve located on the right side of the engine governs the passage of hot gases into the hot-spot.

The exhaust manifolds are on the outside of the cylinder heads and are of three-port design, with the centre port taking gases from the siamesed exhaust ports of the two inner cylinders of each bank. From the middle of the left-hand manifold a down pipe leads round the front of the engine to join the down pipe from the right-hand exhaust manifold. The thermostatically controlled heat valve is located in this short down pipe on the right-hand side. It is of the conventional pattern, being a plate valve, controlled by a bi-metal thermostat spring fitted to one end of the spindle. A counterweight is attached to the other end of the spindle.

The most revolutionary carburation system was undoubtedly that of the Lincoln X100 experimental car. This V-twelve power unit was equipped with the startling array of one four-barrel and four twin-barrel dual carburettors, all of which are of the downdraught type. There are thus twelve carburettor barrels to feed the twelve cylinders. The four-barrel carburettor is arranged in the centre of the V in the manner now common to four-barrel carburettor installations on American V-eight engines. In addition, however, two pairs of dual downdraught carburettors are located over each bank of four cylinders. While full details of operation were unfortunately not available, the arrangement is such that the various combinations are brought into action progressively as engine speed increases. Two barrels of the four-barrel carburettor are in action for town running, all four barrels for cruising, and for high speed operation the four dual carburettors, making eight extra throttle barrels, come into operation. The extra barrels are air flow sensitive, and the whole throttle control system must be highly complicated. A star-shaped air intake fits over the mouths of all carburettors, fed by two large diameter air ducts which lead forward to the two oil-bath air cleaners located in front and to each side of the radiator.

CLUTCHES

No Stagnation in Friction Clutch Development

BY far the majority of vehicles still incorporate a single-plate dry clutch, and despite the difficulties associated with the design of this type of unit, it is now highly developed. Although engineers have been much preoccupied with the numerous problems that have arisen out of the demand for greater automaticity, further improvement of the simple clutch has recently taken place. The past year has seen significant advances, particularly in regard to improved lining materials which have now been brought to the production stage.

Millboard facings have been used extensively in the past and these are still satisfactory where the duty and rotational speed are not too high. However, this material has limited mechanical strength and, with the spring-loaded segment arrangement, attempts to increase the flexibility in compression can lead to trouble with the rivets pulling between the segments. The design problem is further complicated by the trend towards higher engine speeds, and the advent of the square engine may lead to further increases in the future.

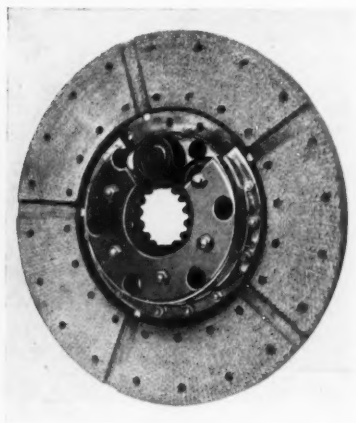


Borg and Beck flexible-centre plate

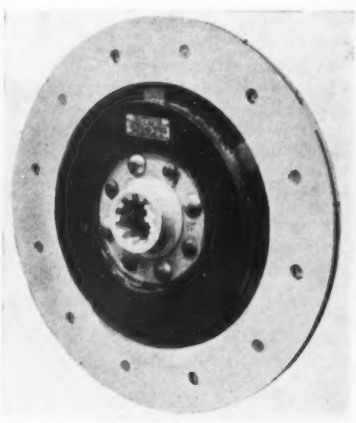
All these considerations have led to a search for materials which have greater mechanical strength, and moulded or wound facings are gaining in popularity. A further requirement which has also been met by the use of new materials is a higher frequency "stick-slip" characteristic. There is still some difference of opinion regarding the degree of compressibility that is desirable in the facing material. One school of thought favours considerable flexibility in order to add to the cushion effect which is normally provided by the spring segments in the driven disc; the other prefers the facing to be as nearly incompressible as possible.

Three types of material have come to the fore to meet these differing requirements. The first is a moulded facing with a random structure, good mechanical strength and low compressibility. The second is bobbin wound, that is, the yarn is wound radially from the centre on a bobbin and then impregnated and cured. This material has some degree of compressibility as well as a relatively high coefficient of friction. The third material is somewhat similar to the second but is scatter wound instead of being symmetrically formed. These wound materials provide a high percentage of asbestos on the contacting faces and are suitable for heavy duties.

The Borg and Beck centrifugal clutch, which has been specially developed for the Manumatic trans-



Layrub centre plate with rubber trunnions



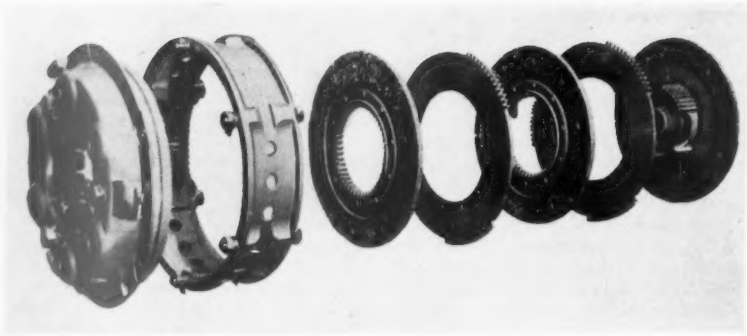
Don flexible clutch disc

mission, is of considerable interest. This unit has been designed to provide for centrifugal engagement and also for momentary withdrawal during gear changes. In order to cater for these requirements, conventional withdrawal levers and a thrust bearing act on a thrust plate instead of directly on the presser plate. Therefore, when the clutch is being re-engaged under the control of the withdrawal mechanism, a gradually increasing spring load is applied to the pressure plate.

If an incompressible driven plate were fitted, an infinitesimal backward movement of the presser plate would free the clutch completely and an equally small forward movement would fully engage it again. Although the driven plate is provided with spring segments which give a degree of compressibility, the total spring movement is small and the rate proportionately high. With normal foot operation, the driver has sufficient feel on the pedal to give successful operation. On the other hand, if an automatic servo withdrawal were used, very fine adjustment would have to be maintained in order to re-engage quickly to the cushion point and then to complete the final and more gentle part of the re-engagement operation.

With the Manumatic clutch, re-engagement is through the thrust plate and relatively low rate springs interposed between it and the presser plate. Hence the re-engagement is not nearly so critical to the distance through which the withdrawal levers have moved, and a rapid re-engagement to cushion point can be arranged without too fine an adjustment being maintained. The addition of a separate thrust plate, moved by the withdrawal levers, would add to the cost of a normal clutch, but it is interesting to speculate on the improvement that could thus be obtained.

The Borg and Beck spring-centre driven plate, employing compression springs to provide torsional flexibility, is in use on the majority of vehicles. One alternative is provided by the Layrub centre, which makes use of the elasticity of rubber trunnions. This unit is being widely adopted in the heavy vehicle field, and larger sizes are used on diesel locomotives. It is also used on the Viscount and Princess aircraft for auxiliary gearbox drives. These widespread applications are an indication of the high technical merit of the system but, doubtless, it is too expensive in its present form for passenger cars. A further variant using rubber is the Don unit made by Small and Parkes Ltd.



Borg and Beck triple-plate racing clutch

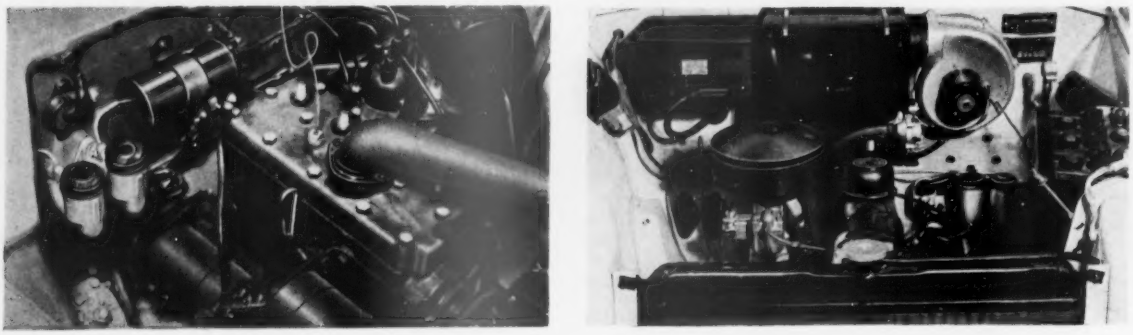
Despite the popularity of the spring centre, it is felt that a simple design using rubber in compression would make a most effective unit at reasonable cost. This type of design would give a steeply rising load : deflection curve, with the inherent damping which is so effectively provided by rubber used in this manner. Such a centre should give increased service life because of the virtual elimination of fatigue and other common forms of failure.

The use of hydraulic controls for clutch operation is becoming increasingly popular. This system has been adopted on the new Standard Eight and Ford Anglia and Prefect models, and it is used in conjunction with the hanging-pedal layout for clutch and brake. In view of the use of this arrangement on even small popular cars, it appears that manufacturers are beginning to give up the almost impossible task of providing satisfactory mechanical linkages which neither rattle nor load the engine mountings and tend to promote judder.

A most interesting development was exhibited on the Borg and Beck stand. It is the 7½ in diameter triple plate clutch, as used on the B.R.M., Gardiner's M.G., and on the Jaguars at Le Mans. This clutch has been designed specifically for competition purposes for which, because of the exceptionally high crankshaft r.p.m. attained by modern racing engines, it is of particular value. It will doubtless be in great demand for the new Formula I racing cars and it is most encouraging to see such a unit is available.

The new clutch, by virtue of its smaller diameter, gives lower centrifugal loading on the flywheel, etc. This reduced diameter also, of course, makes possible the use of a smaller bell-housing. A useful reduction in the height of the transmission line could be effected by incorporating a clutch of this type in conjunction with an all-indirect gearbox built in unit with the final drive.

The inertia of the three small-diameter driven plates is less than that of a single plate for an equivalent application, so quicker gear changes should be possible. The clutch is semi-centrifugal in action, that is bob-weights increase the clamping effect. The friction faces have a high coefficient of friction but, since the linings are both bonded and riveted, the mechanical strength is not of great importance and reliability should be ensured. As will be seen in the illustration, the multiple plates are enclosed in a drum-like housing.



Bulkhead mounting of master cylinders for hydraulic actuation of clutch and brakes. Left, new Ford Anglia and Prefect : Right, Standard Eight

GEARBOXES

Increased Adoption of Overdrive Units. Improved Lubrication. Decline in Popularity of Steering Column Controls

THE Standard Motor Co. Ltd. by their adoption of a four-speed gearbox on the new 8 h.p. car have fallen into line with the majority of small-car manufacturers. Other vehicles in this category include the Austin A.30, Morris Minor, Fiat 500, Citroen 2CV, and Volkswagen. The last two named have their engine and final drive units grouped together, in one case at the front end and in the other at the rear. Both use all-indirect gearboxes and the highest gear is an overdrive which, of course, has to be engaged by use of the normal clutch and gear lever.

A point of interest is that in the Standard Eight the relatively high axle ratio of 4.87 has been adopted, as opposed to 5.13 on the Austin A.30 and 5.375 on the Morris Minor. It would have been impracticable to use this ratio had a three-speed gearbox been used. The rear-engined Renault 750, with only a three-speed gearbox, uses a top gear ratio as high as 5.05. In this case, the gearing problem is doubtless easier because of the low weight of the vehicle, 11 cwt, but there must be many cases where the second gear ratio of 8.72 has to be used where a higher third gear would be appreciated.

In the new Ford Prefect and Anglia, a three-speed box is again used, but the axle ratio is surprisingly high, at 4.429 instead of 5.5 on the Popular. It is significant, however, that the torque of the latest engine in the new Prefect and Anglia has been increased 50 per cent, from the 36 lb-ft of the earlier models, to no less than 54 lb-ft, and this more than compensates for the higher gearing. In view of the kerb weight of about 15 cwt, a very good performance can be expected, and there should be no need under normal main road conditions for frequent changes down from top gear.

The basic design of the Standard Eight four-speed gearbox can be regarded as orthodox, with synchromesh on second, third and top. A straight spur gear for first speed is carried on the second-speed synchro unit. This makes the box remarkably compact so far as length is concerned. From a design viewpoint, the main interest in this unit lies in the long spigot bearings provided, and in the care taken to ensure adequate lubrication within the gearbox main casing. Both the spigot of the gearbox first motion shaft into the flywheel, and the spigot of the third motion shaft, have bearings about $1\frac{1}{8}$ in long.

An ingenious lubrication system has been incorporated; the solid laygear cluster is carried on long bearings on the fixed shaft, the rear end of which extends through the wall of the box into a well in the rear extension. Oil passes from the rear end of this shaft along a flat and thence to a coarse scroll machined on the periphery of the shaft along almost its whole length inside the the laygear cluster. The rotation of the cluster round the scroll feeds oil towards the front end of the box. About midway along the front layshaft bearing, the scroll ends and is coincident with a radial drilling; this radial drilling feeds the lubricant into an axial passage through which the oil is taken to the front end of the shaft. From this position, it goes vertically upwards and thence through a radial hole to an axial hole in the first motion shaft.

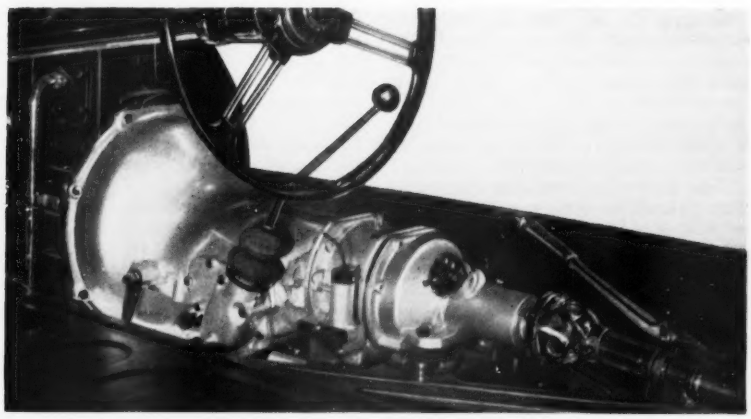
A copious supply of oil is thus fed to the spigot bearing between the first and third motion shafts. From there it flows through an axial drilling, some three inches long, in the front end of the third motion shaft. It then feeds through a radial hole and oil grooving to lubricate the plain journal and thrust faces for the third and second speed gears. In normal designs, these bearings frequently give trouble, and in particular they are inclined to wear at their ends due to the tipping forces on the gears. Any wear at this point can cause serious noise and has sometimes been suspected of being the cause of gear failures. This carefully devised lubrication system can, therefore, be regarded as a step forward in the design of orthodox layshaft gearboxes.

With regard to gear shift controls, both the Standard Eight and the latest Ford models have central floor-mounted gear levers. These small cars cannot be expected to seat three passengers abreast on the front seat, and there is therefore no virtue in providing a gear lever on the steering column. Many drivers will welcome the retention of the central lever, which is often regarded as being easier than the steering-column type to operate. The reasons for the wide adoption of automatic transmissions in America are well known, but there is cause to wonder whether the change was hastened by the advent of the steering column shift mechanism, which was not universally popular, and which gave rise to an increase in complication and also in the need for adjustment in service.

While on this theme, it is of interest to record that the Rover Company Ltd. have abandoned a steering column shift in favour of an ingenious "turret" mechanism, which has a straightforward mechanical linkage and hence feels completely positive. The device is adjustable in order to give individual drivers opportunity to alter the position of the lever to suit their own requirements. The new Rovers, incidentally, provide synchromesh on second gear as well as on third and top.

In the report on last year's Show comment was made upon the adaptation of gearboxes, originally designed for steering column shift, for central levers; this is often required to suit sports car installations. A particularly neat example was to be seen on the Austin-Healey 100. In this gearbox a completely new side cover casting has been made to house the central lever mechanism, and this results in a business-like control of considerable rigidity. The illustration also shows the installation of the Laycock-de Normanville overdrive, which will be referred to later.

The Aston Martin DB3S and the Pegaso models continue to fit five-speed gearboxes, and the Fiat 1900 is similarly equipped. This feature is quite understandable on the first two cars, which



Installation of gearbox and overdrive in Austin Healey 100, showing remote control, overdrive governor and solenoid

come into the super sports category. However, although some experienced drivers will certainly like this feature on what might be described rather as a high performance touring model, others will certainly feel that a fifth speed is only really useful if there is at least some measure of automaticity in its engagement.

The Manumatic system

Having dealt with some of the interesting features on orthodox gearboxes, we now come to the next stage in evolution, that is, the Manumatic gear-control system. This was described in last year's Show report and later was featured in the February 1953 issue of *Automobile Engineer*, so it is only necessary to describe developments that have taken place since this time.

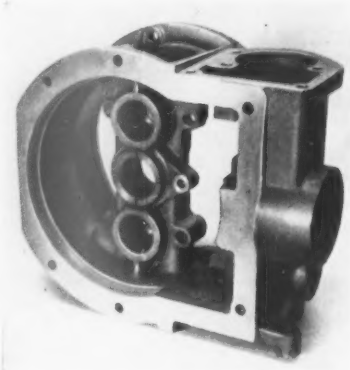
As exhibited last year, the clutch pedal was retained, although definitely not required for normal purposes. One reason for its retention was to provide for tow starting; operation of a catch permitted the pedal to be depressed and then released again to engage the clutch. In the latest version, a separate lever operated by the driver is used when tow starting.

Clutch withdrawal for gear changing is effected by release levers which move a thrust plate. The ends of these levers are moved by a thrust bearing actuated by a more-or-less conventional withdrawal fork. Thrust springs are inserted between the pressed steel clutch cover and the thrust plate. Forward of the thrust plate is the presser plate which, under normal circumstances, is moved forward by the centrifugal force applied to the bob weights as the engine speed increases. When the centrifugal loads decrease as the engine speed is reduced, the presser plate is normally returned by relatively low pressure springs.

The driven plate is clamped at a relatively low r.p.m., this being the clutch pressure point. However, as the engine speed increases the bob weights continue to fly out and thus move the thrust plate further to increase the loading on the springs; eventually the bob weights reach full travel and come up against stops. During this movement of the thrust plate, the tips of the withdrawal levers are drawn forward, clear of the release bearing. Thus, when the engine is stationary or running at normal tick-over speed, the pressure of the thrust springs is taken by the release bearing, which is then in its static position.

For a tow start, the clutch must be engaged while the engine is stationary; to do so, it is necessary to lengthen the linkage between the clutch servo and the release bearing. This moves the release bearing rearwards and the thrust and the presser plates are thus forced forwards by the thrust springs, to clamp the driven plate and engage the clutch. The clamping effort required to turn the engine at the relatively low speed for starting is not great, hence only a small effort will be required to operate the manual tow start lever if a reasonable mechanical advantage is provided.

Considerable development work has gone into the gear lever switch, which initiates the clutch withdrawal, synchronization, and re-engagement. Last year this was shown as a position-responsive switch, that is, contacts were closed as soon as the gear lever was moved far enough to take up the initial backlash. The driver could remove his hand from the gear lever in any intermediate position without re-opening the contacts.



Die-cast light-alloy main casing for Laycock-de Normanville overdrive

An alternative arrangement is now envisaged in which the switch is pressure-sensitive rather than position-sensitive, that is, once the driver has applied pressure to the gear lever, without necessarily having moved the gear mechanism at all, the switch contacts are closed. If the driver releases the gear lever in any intermediate position, the contacts immediately remake. Thus the driver can double de-clutch, if he so wants, without a clutch pedal, but this facility is not considered important. There are advantages and disadvantages relating to both systems. Lockheed are not necessarily wedded to either and this is a matter on which the car manufacturer will, doubtless, have his own views.

Laycock-de Normanville overdrive

During the last year an important development among production cars has been the increasing use of the Laycock-de Normanville overdrive. The unit is being produced in quantities and the suitability of the design for mass production may be seen from the illustration of the die-cast main casing.

The American demand for sports cars has virtually created a new industry, within the motor industry, for the production of these vehicles. British manufacturers have responded by making, at a competitive price, what can be described as a new breed of ultra-high performance sports car. Nearly all these new sports cars offer the overdrive either as standard or as an optional extra. Sheer speed is not, of course, the only performance criterion of sports cars, but some measure of the progress made can be seen in the timed runs of some of these vehicles in racing trim. Speeds varying from a modest 120 m.p.h. up to the staggering figure of about 175 m.p.h. have been recorded.

It will be appreciated that a top-gear ratio to permit such speeds, without serious over-revving of the engine, is much too high to provide good performance at the lower pace at which most buyers of these cars will drive them. The overdrive provides a solution. It permits the use of an axle ratio low enough to give really good acceleration and hill climbing characteristics in direct top gear, while it also allows really high top speeds without over-stressing the engine, and gives comfortable cruising with low fuel consumption. The average owner, particularly in America, would not be willing to make clutch and lever gear changes to meet this end.

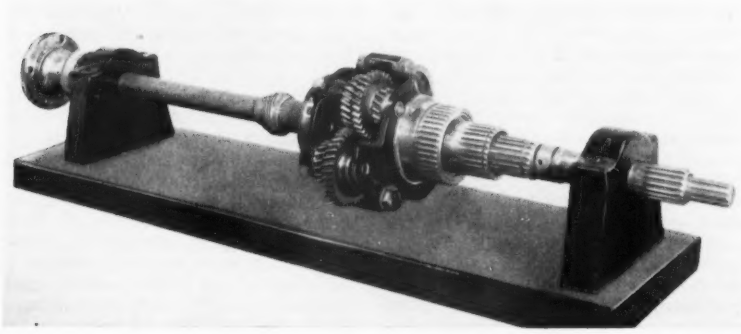
Although the family car is not quite a parallel case, this type of vehicle more than any other should be able to accelerate and climb hills easily, and so it requires a low top gear. On the other hand, drivers now also demand effortless cruising and low fuel consumption, and this necessitates a high top gear. With an overdrive installation and carefully chosen final drive ratio, it is possible to satisfy both these conflicting requirements without calling for any extra effort from the driver. It is for this reason that increasing interest in overdrive is so evident. Since last year's Show, three main lines of development have taken place in order to meet all the different requirements.

Mechanical modifications for high power.—Relatively high powers have to be catered for in a number of current applications of the overdrive unit, and in one as much as 200 b.h.p. has to be transmitted. The basic Laycock-de Normanville unit has a 1⅛ in diameter input shaft, which is adequate for these conditions. The only major modifications required on units for higher powers has been the substitution of caged needle-roller bearings of the Torrington type, for the plain lead-bronze planet-pin bearings previously used.

Hydraulic modifications to cater for overdriving indirect gears.—There are considerable advantages in overdriving indirect gears, as for instance the second gear, in addition to top, in a three-speed gearbox. In all existing installations the overdrive unit is mounted behind the gearbox and therefore has to transmit the multiplied torque of the lower ratio. The overdrive reaction clutch is engaged by the hydraulic load transmitted by the two operating pistons and in order to transmit higher torques, this load must be increased. In the earlier models the plunger pump delivers into a hydraulic accumulator consisting of a 1¾ in diameter piston spring-loaded in a cylinder. The spring has a low rate and it is compressed by the hydraulic pressure until the piston uncovers blow-off holes.

When the control valve is operated to engage overdrive, the operating pistons move over to engage the clutch and the oil displaced is recuperated from the

accumulator. Because of the large accumulator piston area, which calls for only a small movement for a relatively large volume displacement of fluid, and the low spring rate, the pressure drop is negligible. Hence the clutch engages under the same load irrespective of the torque being transmitted, that is, irrespective of the position in which the throttle pedal happens to be maintained by the driver. On a car such as the Standard Vanguard, with a maximum engine torque of about 110 lb-ft and overdriving top gear only, this worked satisfactorily, although the change was smoother when the throttle was opened wider.



Gear train of Hobbs transmission

When a second gear torque has also to be taken in overdrive as for instance on future Vanguards, greater hydraulic pressure is necessary to cater for the higher torque. This excess pressure would cause excessively fierce engagement of the clutch if overdrive were brought into play at very small throttle openings. This disadvantage has been overcome by reducing the diameter of the accumulator piston and thus increasing its travel for the same displacement of oil into the operating cylinders; while at the same time a spring of relatively high rate is used. With this new system, there is momentarily a considerable drop in pressure when overdrive is engaged. The pressure is built up again by the action of the pump in recuperating the accumulator, this operation taking, say, three-quarters of a second.

If a change into overdrive is made at a very small throttle opening or on overrun, the clutch begins to engage almost instantaneously at a low pressure, and slips for a brief period at a small frictional load to obtain synchronization. At larger throttle openings, there is a slight delay while the pressure is built up to a value adequate to cause complete engagement. Full engagement is, therefore, always effected at the clutch load applicable to the torque being transmitted.

Semi-automatic control system.—An electric semi-automatic control system has been evolved by Lucas for the overdrive unit, and this is in production for a number of models, one of which is the Austin Healey 100. The basis of the design has been to provide automatic engagement and disengagement of the overdrive at fixed speeds, with an over-riding control which can be used at will by the driver to disengage the overdrive. The manual control does not permit engagement of overdrive *below* governor speed.

The main components of the control are a centrifugal switch and a solenoid, the latter being energized through the medium of a relay or relays. In addition there is a manual over-ride switch and a further switch actuated by the gear shift mechanism. The object of this last switch is to prevent the use of overdrive except when in top gear, or top and second or third gears in a number of installations. An indicator lamp is sometimes used, which remains alight so long as the electrical circuit is operative and hence when overdrive is engaged.

The circuit diagram for a typical installation is shown in the section of this Show report which deals with electrical equipment. The system is specifically designed to preclude the use of overdrive when it is undesirable that it should be brought into operation, and three conditions must be satisfied before a change to overdrive can be made. They are:—

(1) The appropriate gear must be in engagement. Normally this is top or second gear, but sometimes top only. The engagement of the appropriate gear closes the contacts of the top gear switch, which is mechanically actuated by the gear shift mechanism.

(2) A certain minimum road speed must have been reached. This speed is determined for each particular installation and the centrifugal switch is set so that the contacts close when it is reached.

(3) The driver must have elected to use overdrive, by closing the manual switch.

When these three conditions are met, the current flow is as follows:—

(1) From the supply terminal to the top gear switch.

(2) Through the top gear switch to the manual switch.

(3) Through the manual switch to the relay coil to earth.

(4) By virtue of the electro-magnetic effect of the relay coil, contacts A and B are closed. Therefore the current flows from the manual switch through contacts A to the solenoid and warning light.

(5) The current now flows to earth through a solenoid closing coil at low resistance and a holding coil, in parallel, of high resistance. Both coils exert an electro-magnetic effect on the soft iron plunger which actuates the control valve so that overdrive is engaged. Movement of this plunger also opens the contacts of a switch which is built into the top of the solenoid. These switch contacts are in series with the closing coils, so the magnetic effect of the holding coil only then acts on the plungers. This is adequate to keep the control valve in the overdrive position, with only a small current consumption.

As a refinement, means are provided to prevent the driver from making a down change from overdrive to direct with the throttle fully closed. At high speed this would cause instantaneous engine braking which would be disconcerting. Even at low speeds there are advantages in preventing a change under these conditions. This safeguard is provided by relay contacts B and the throttle switch. The throttle switch is connected mechanically to the throttle linkage and adjusted so that when the throttle is closed, the contact points are closed and remain so until the throttle is approximately one-fifth open. With the relay contacts B and the throttle switch closed, there is an alternative path for current flow from the top gear switch to the relay coil, by-passing the centrifugal switch and the manual switch.

Therefore if the car slows down from a moderate speed with closed throttle, the breaking of the contacts of the centrifugal switch at the appropriate speed will not cause a down change, but it will take place when the throttle is opened again. Likewise, at high speed, operation of the manual switch to throw out the overdrive will not be effective unless the throttle is at least partly open. The same effect is obtained on an alternative circuit using two standard relays instead of the special double relay described.

Fully automatic transmissions

The Hobbs automatic transmission was referred to in last year's report. Since then a great deal of development work has been done. The transmission exhibited this year is suitable for passenger cars with engine torque of up to 85 lb-ft, and a unit was installed in a 1½-litre car which was available for demonstration at Earls Court. In view of the interest being shown in this design, some comments will be made on a number of the salient points. The general features of the transmission are already known, but modifications were made in the gear train about the time of last year's Show. In order that those not already familiar with this epicyclic design may understand some of the detail features of operation and control, it will be necessary briefly to describe the unit.

The basic elements of the planetary

gear system include four sun wheels, but the annulus previously used is no longer incorporated. The sun wheels are integral with the output shaft and the transmission path for the various gears is as follows. For neutral, all clutches and brakes are disengaged. When in reverse, clutch 8 is engaged and brake 3 is applied. The drive is thus taken from the engine to sun 6; the cage is held stationary by brake 3, and the pinions rotate at about three-quarters of engine speed to drive sun 5 backwards. For all forward gears, clutch 9 is engaged and the drive from the engine is therefore taken to sun 4. In bottom gear, brake 3 is applied to hold the planet cage. It will thus be seen that the heavy torque reactions of reverse and bottom gears are both taken by the same brake. The planet speeds in bottom are about the same in reverse.

The change to second gear is effected by releasing brake 3 and applying brake 2. This application of the brake locks sun 7, and the cage rotates forwards at moderate speeds, while the planets rotate at about half engine speed. When a change is made to third, brake 2 is released and brake 1 applied to lock sun 6. This causes the cage to be driven at a greater speed, while the planets rotate on their own axes at about one-fifth of engine speed.

To engage top gear, all the brakes are released and clutch 8 is engaged in addition to clutch 9 which has been engaged for all forward speeds. The engine is then driving sun 4 and sun 6; hence two elements of the train are locked together and a direct drive is obtained. Under this condition the cage rotates at engine speed and the planets do not rotate about their own axes. It will be seen that all the changes are timed, that is, it is necessary to commence engagement of the new brake or clutch before releasing the previous one, thus momentarily allowing slip on the brakes or clutches, with two gears in at once, in order to prevent engine run-away. The timing is effected by regulating the rate of exhaust of hydraulic fluid. This is done by means of spring-loaded capacity chambers, or dash pots, and by limiting the size of inlet orifice for the element about to be engaged.

On the unit exhibited, the operating hydraulic pressure is of the order of 130 lb/in² for reverse, 100 lb/in² for bottom, 50 lb/in² for the higher intermediate gears and 30 lb/in² for top. It has been possible to keep these pressures low, because of the large surface area on which they act. The pressure operates synthetic rubber diaphragms of annular form, which are about the same diameter as the friction surfaces. These diaphragms enclose a shallow annular space and are retained by rings at their outer and inner peripheries. An insulator plate is sandwiched between the diaphragm and the presser plate to prevent the transmission of heat to the diaphragms. The presser plate, loaded by the diaphragm, clamps the driven plate or plates in the usual way.

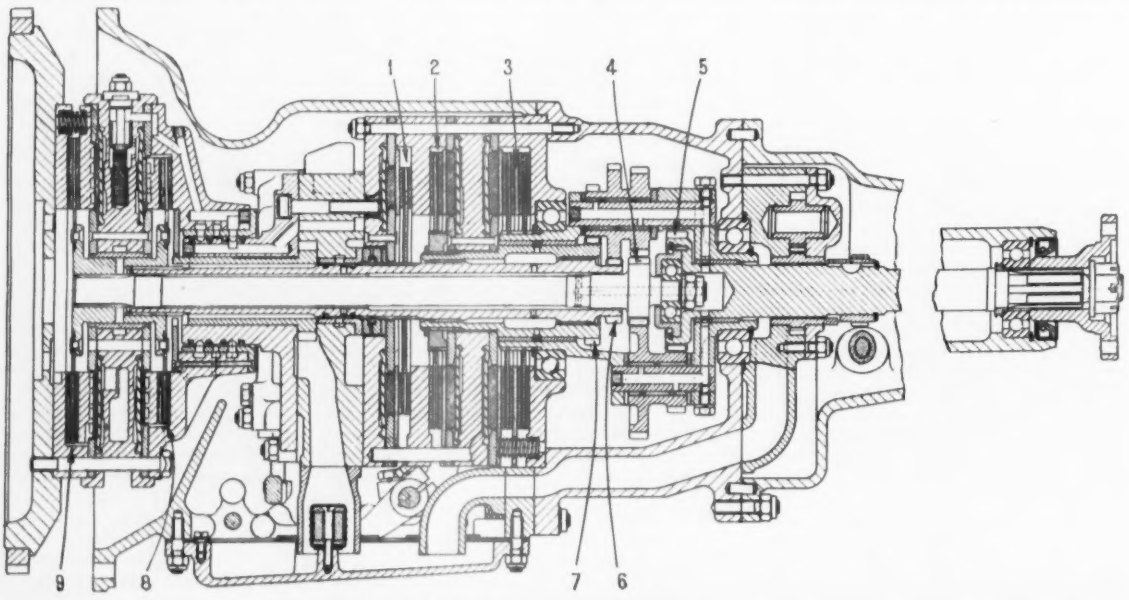
The heart of the hydraulic unit is an orthodox gear pump, of relatively large capacity, driven from the front of the transmission. From the pump the feed is taken to the brake relief valve, which controls the primary pressures feeding the brakes. The valve is of the piston type with a number of shoulders, and the differing pressure requirements for different gears are provided by feed-back of pressure on to the various shoulders, which provide differences in the effective area on the two sides of the valve.

From the brake relief valve the oil feed is taken to a second piston valve which controls the clutches. This valve again makes use of a shoulder and pressure feed-back to reduce the pressure to 30 lb/in² in direct drive. A feed for lubrication is taken in front of the blow-off from the clutch valve. In top gear, the torque is shared between the two clutches. When engaging top, clutch 9 is already engaged and, therefore, does not have to slip; because of its static condition, the coefficient of friction is relatively high. Clutch 8 has to be engaged, with a slip period, but this takes only about two-fifths of engine torque, depending on the gear ratio, and a low operating pressure is therefore adequate.

An extension from the clutch valve can be interconnected with the throttle linkage. This has the effect of biasing the speeds at which the various changes take place and thus, under the action of the governor system which is described later, makes the system responsive to torque as well as speed.

The hydraulic unit just described provides the energy for engagement of the clutches and brakes, and controls the pressure for the various conditions. Power for the control or governor system is provided by another gear-type pump driven from the rear of the unit. The duty of this pump is primarily to operate the automatic unit, but when third gear is engaged, a transfer passage communicates between the pump and the hydraulic actuating unit. Thus, when the gear lever is operated to select third, pressure is available for engagement of the appropriate clutch and brake to engage the gear, even though the front pump, which is driven by the engine, is not running. Tow starts may, therefore, be made in third gear.

Bottom gear is manually controlled only, the automatic operation being restricted to second, third and top. A manual over-ride is provided for the higher gears and the gear lever quadrant therefore provides for R, N, 1, 2, 3, A.



Longitudinal section of Hobbs transmission

The delivery from the rear pump is fed to one end of the governor valve, the other end being provided with a reaction spring. Pressure from the clutch-actuating circuit can also be fed to the other end of the valve, to add to the spring pressure. The means of controlling this, by a throttle linkage interconnection to the clutch valve, has already been described. The governor valve comprises a long vertically positioned piston in a suitable bore. In the bottom portion of the valve is contained a series of cross drillings which form ports to deliver oil to the appropriate clutches and brakes, and some additional ports which provide for a bleed of oil from the clutches and brakes.

These ports are opened and closed in a sequence depending on the vertical movement of the piston. The top of the piston, on which acts the pressure from the rear pump, acts as a cut-off valve for the series of bleed holes. At low speed, the pressure supplied by the rear pump is insufficient to compress the reaction spring, and the piston valve is at its topmost position. Here, one jet is permanently open, allowing the escape of a metered quantity of oil. With the valve in this position, second gear is engaged by the delivery of pressure oil from the front pump through the ports in the bottom of the governor piston valve to the clutches and brakes.

As the speed of the car increases, so the speed of the rear pump increases, and the back pressure against the exhaust from the single bleed hole also increases. In consequence, the piston valve is depressed against the load of the reaction spring, until it has travelled down far enough to uncover a second bleed hole. This immediately causes the pressure to drop and a state of equilibrium is reached by virtue of minute oscillation of the top face of the piston valve which causes the effective area of the second bleed to be varied to cater for fluctuations of pressure in the system. Further movement of the piston valve causes other ports formed in the bottom of the valve to coincide, and engages third gear. When there is sufficient pressure to depress the piston still further to uncover a third bleed hole, the process is repeated for top gear.

Downward changes are effected in a similar manner as the car speed drops and the pressure falls. There is one additional control, which is of the kick-down type. This is linked to the throttle system and opens an additional bleed hole, and then a higher output pump speed is required to effect the various changes.

The various American torque converter transmissions continue to be used, but with modifications which, while minor in themselves, are of considerable significance. In a car with a really large engine, such as the 5.5-litre Chrysler in which the aim is at luxury travel without too much regard for ultimate performance or optimum fuel consumption, the torque converter is expected to serve for all normal driving; the two-speed gear is regarded as being for emergency conditions only. However, on a car such as the Chevrolet with a more modest four-litre engine, experience has shown that this arrangement is far from perfect. Accordingly, this year's models incorporate automatic up- and down-shifting of the two-speed gear, which was previously manually controlled.

Ford and Mercury continue to use a three-speed train behind the torque converter, and Studebaker retain three speeds and a lock-up clutch. The function of the torque converter is thus virtually restricted to that of a starting clutch which, in conjunction with the gearing, can also provide an emergency low.

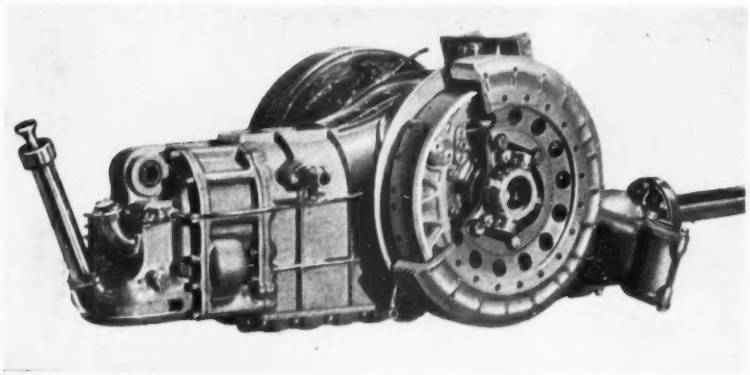
Cadillac and Lincoln vehicles were again exhibited with the Hydramatic transmission, which is in a class by itself. It is to be regretted that the disastrous fire at the General Motors Corporation manufacturing plant will temporarily interrupt the supply of this unit, but if extensive re-tooling is necessary to make good the damage, it would provide a convenient opportunity for making any desired changes in design. Rolls-Royce now manufacture under licence their own version of this transmission, termed the "Automatic Gearbox", and are thus able to offer cars so equipped on the home market.

REAR AXLES AND PROPELLER SHAFTS

Little Change but Wider Interest in Fixed Final Drive

REAR axle and propeller shaft design has temporarily reached a state of stability. Although there are exceptions, the pattern commonly adopted is a banjo-type axle, of the semi-floating variety, with a hypoid crown wheel and pinion. So far as the propeller shaft is concerned, the Hardy Spicer unit with needle-roller bearings is almost universally employed. The sliding joint is generally at the gearbox end, where in most applications it is totally enclosed.

The new Ford Anglia and Prefect models continue with a revised version of their well-tried small axle, the ratio being changed from 5·5 to 4·429. The Standard Eight has a new semi-floating banjo axle with hypoid drive gears, the pinion being offset about $\frac{3}{4}$ in below the centre line. Pre-loaded taper needle-roller bearings are used both for the pinion mounting and for the differential assembly. The pinion nut, which is of the self-locking type, is tightened to 70 lb-ft by means of a torque-limiting spanner. Shims are provided for bearing nip on the differential assembly. Self-locking nuts are also used on the half-shaft ends, these being tightened to 110 lb-ft. The two-pinion differential has a carrier of the usual one-piece type, with a bolted-on crown wheel. A detail point of interest is the neat pressing on the flange coupling, to reduce the risk of dirt particles finding their way to the oil seal. Care has been taken in the layout of the twin oil seals and the trap at the half-shaft ends, to preclude the possibility of oil finding its way out on to the brake shoes.



On the Pegaso the gearbox is located to the rear of the final drive

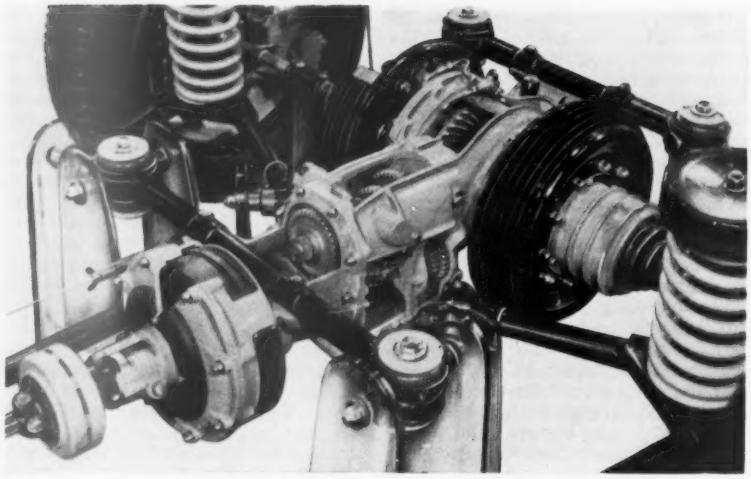
Although small cars of orthodox front-engine and rear-drive design will, no doubt, continue to use conventional rear axles for many years to come, it

is generally recognized that a change is overdue for high-powered vehicles. In the sports car class it is now possible to buy cars with engine outputs exceeding 200 b.h.p. per ton of overall car weight. The problem of providing good rear-wheel adhesion is, therefore, most difficult, and the use of a de Dion rear axle and independent rear suspension would be of considerable assistance. Even in the larger saloons, the power:weight ratio is in some cases so high that the cars can be dangerous in the hands of unskilled drivers.

Apart from the question of improving adhesion by relieving the rear wheels of the propeller shaft torque reaction, the advent of a final-drive bevel assembly mounted on the chassis, or chassis-body structure, allows the gearbox to be transferred from the front to the rear of the car. This can have a significant effect on weight distribution which in turn, provides a further improvement in rear-wheel adhesion. On touring cars, there is another aspect that shows an advantage to be gained by mounting the gearbox in unit with a fixed final-drive assembly. There is a limit to the amount by which an engine with unit gearbox can be moved forward and even when the utmost has been done, the gearbox still tends to interfere with the passenger space, particularly when a low floor level is adopted.

Furthermore, ride may be improved by increasing the moment of inertia of the vehicle by positioning the heavy fixed masses towards the front and rear extremities. A rear gearbox improves this condition, although there is every reason to avoid an excessive concentration of weight at the back. However, now that inter-axle seating, with the rear squab forward of the back wheels, has become firmly established, the tendency is to place more weight than ever before on the front. This forward positioning of the rear seat makes space for a gearbox available forward of the rear axle centre line.

A number of layouts have been adopted for the gearbox and final drive arrangement. Pegaso mount a spur gearbox behind the axis of the rear wheels. The input drive is taken under the differential and then upwards through a spur gear train to the output shaft, the end of which carries the final drive pinion. This indirect arrangement permits the adoption of a low propeller shaft position.



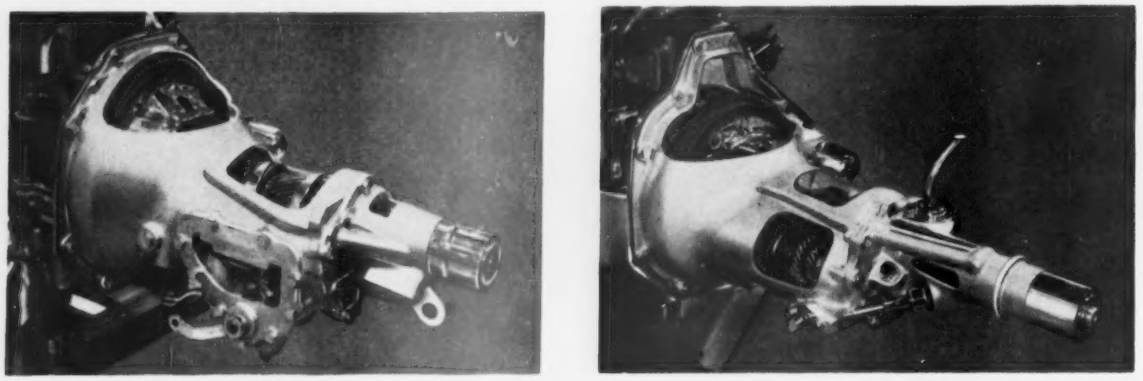
Clutch, gearbox and final drive assembly on Lancia

An alternative indirect arrangement could be seen on the Lancia stand. In this case, the gearbox is ahead of the rear wheel axis. The small diameter clutch at the rear end is retained. Both the Lancia aand Pegaso layouts incorporate inboard rear brakes which, because they are fixed relative to the frame, lend themselves to simple operation, reduce unsprung weight, and are less likely to be subject to brake hop troubles. The advent of automatic or semi-automatic transmissions will ease the admittedly difficult control problem associated with the remote positioning of gearboxes.

On British cars, such as the Aston Martin, Lagonda and Allard models, the de Dion or independent rear suspension is usually adopted. On the Salisbury stand there was a final drive assembly specially developed for such installations. Possibly there is scope for further developments by component manufacturers, directed to the production of a complete gearbox and final drive unit.

The advent of the reverse spline propeller shaft, that is, with the sliding joint at the front, has the major advantage that it eliminates a greasing point that was frequently ignored in service. It also simplifies the gearbox rear end and the mating portion of the propeller shaft. Unless adequate provision is made for lubrication, however, there is a risk of considerable heat being generated in the tail-end bush by the combined rotating and plunging loads. The illustrations of the Austin A.40 and A.30 sectioned transmissions show the considerable care that has been taken to lubricate this component by forming ducts in the gearbox main casing and rear extension. These ducts are fed with splashed oil and carry it to the rear extremity, to lubricate the tail bush.

While the Hardy Spicer type needle-roller universal joint holds the field in orthodox car designs, there is much interest in the various designs of rubber universal joints. With a fixed final drive, the angularity requirement is not so great, and the larger diameter of the rubber unit will not always prove to be a limitation, hence the advantages of the torsional flexibility of these rubber universal units may lead to their increasing popularity for these special installations.



Ducts convey oil from the gear casing to the tail end bush on Austin A40 (left) and A30 (right) gear units

FRONT SUSPENSION AND STEERING

Individuality of Design Maintained. Some Standardization of Components

THE 1953 London Motor Show did not reveal any new basic developments in the sphere of front suspension and steering, but abundant evidence of detail developments was provided by some of the cars exhibited for the first time. Although conventional designs are still favoured, more detailed attention is being paid to all those aspects of design which make it possible to use the largest possible number of standard proprietary components without affecting individuality of suspension and steering layout.

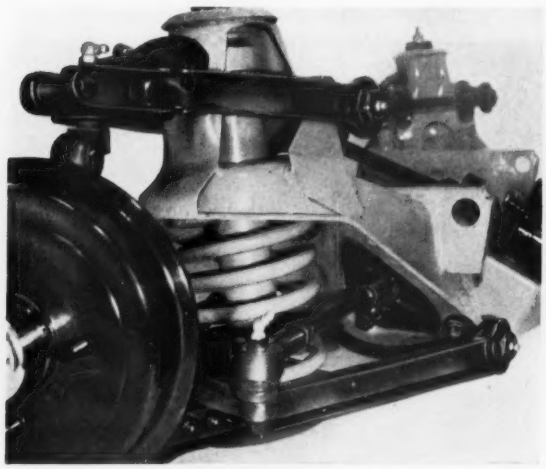
Whilst the wishbone and coil spring type is the most common form of front suspension, several manufacturers favoured the use of torsion bars and, in particular, laminated torsion bars where the available chassis space is limited. The type of steering gear is still largely dictated by the engine position and the available under-bonnet space in relation to the seating position of the driver. This aspect can, however, be summed up by saying that wherever the engine has not been placed as far forward as is now common practice, the rack-and-pinion type of steering gear is favoured, but on the majority of cars exhibited cam-and-roller or worm-and-peg-types are employed. It is of interest to note that the recirculating-ball type of steering gear is rapidly gaining in popularity and is employed on several new American cars, even where the steering motion is power-assisted. The pinion-and-bevel segment type of steering gear was used only on the German B.M.W. "501".

With the distinctly marked trend towards smaller cars, the front suspension and steering layout of various popular British and foreign models offered interesting points for comparison. In the new Standard "Eight", which has a unit-construction body, the complete front cross member with the front suspension unit and steering gear is attached to the body structure by four high-tensile bolts. While the front bolts are located horizontally and transversely across the frame on each side of the cross member, those in the rear are positioned vertically. To reduce the level of noise transmitted to the body to a minimum, all four bolts are rubber mounted. The suspension system itself consists of wishbones, coil springs and centrally mounted telescopic shock absorbers. The upper and lower wishbones are each made up from two channel-section steel pressings. Screwed bushes are used at the inner ends of both the upper and lower wishbones, while at the outer ends of the upper wishbones the housing for the swivel forging ball-joint is secured between the two pressings by two high-tensile bolts. Adjacent to the upper ball-joint housing and positioned on a channel-section steel pressing tying the two wishbone members is a rubber rebound buffer. At the outer end of the lower wishbone a screwed bush is used to permit steering movement, and this is also provided with a bearing arranged at 90 deg to the kingpin axis to permit normal suspension movements.

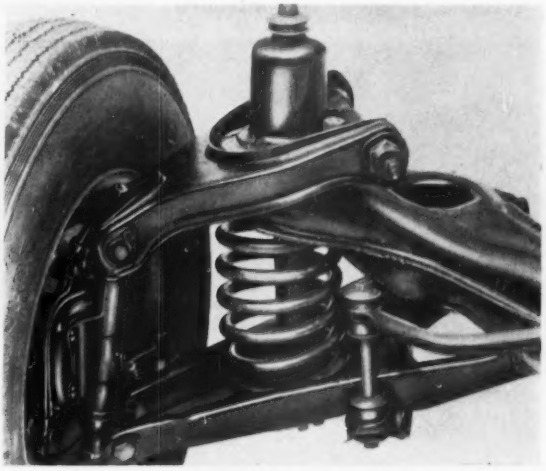
The swivel forging is machined at its lower end to mate with the screwed bearing, whilst its top lug is taper-bored for the attachment of the ball joint. The main pressing of the front cross member is swept up to form a spring pan and has an additional pressing above the spring pan to house the upper end of the telescopic hydraulic shock absorber. The inner bearing housings for the top wishbone are attached to this top pressing and owing to the position of the attachment point, it is possible to adjust the camber angle of the suspension by means of shims placed between the top bearing housings and the frame pressing. The wishbones are semi-trailing, being set at an angle of 65 deg to the longitudinal centre line. Adjustment to the castor angle can be made by varying the thickness of packing pieces placed next to the rubber bushes at the cross member rear attachment points.

The hydraulic telescopic shock absorber mounted inside the suspension spring is attached to the bottom wishbone with a rubber bushing, the base of which is bolted to the lower spring pan. The top end of the shock absorber is secured with two thick rubber washers to the metal pressing above the upper spring pan. A three-piece track rod system is used, the two outer rods being attached to forward-facing stub-shaft levers. The cam-and-peg type steering gear is positioned ahead of the general line of the track rod, so that the steering lever and corresponding idling lever, which is attached to the opposite side of the cross member, extends back to the joints on the centre section of the track rod which is located within the front cross member. This arrangement permits a simple interchange with the usual identical components from right-hand to left-hand, this being accomplished by removing the end cover plates positioning the idling lever, the bolt holes of which match the location points of the steering gear.

An entirely different approach to the design of front suspension and steering layout for small cars was to be found in the new Ford "Anglia" and "Prefect". Although the layout adopted for these two models is almost identical in basic principle to that employed in the larger "Consul" and "Zephyr" models, its application to smaller vehicles would



On the Standard Eight the track rod passes through the front cross member



Mercedes Benz 130 front suspension



Front suspension unit for Ford Anglia and Prefect

appear to indicate a trend in suspension design. The steering swivel of each front wheel extends upwards from the lower section of the telescopic hydraulic shock absorber, the upper part of which is surrounded by a coil spring. The reaction of this direct supporting unit is taken on the main structure of the unit-construction body through a substantially dimensioned rubber-bonded mounting.

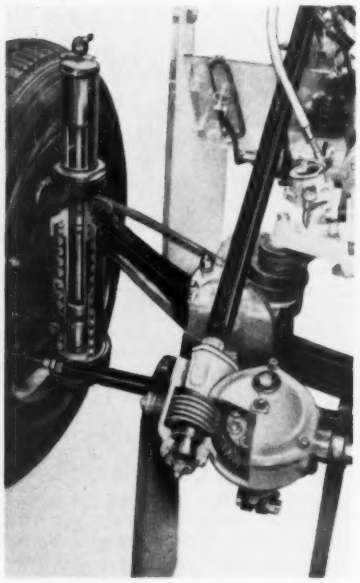
Fore-and-aft and transverse location is provided by a radius arm, into which the lower end of each telescopic suspension unit is mated with the aid of a ball-joint, and by an anti-roll bar. A Burman worm-and-peg steering gear, matched by an idler unit located on the opposite side of the body structure, is employed in conjunction with a three-piece track rod.

On the latest Panhard "Dyna 54" the designer finds it advantageous, owing to the forward position of the horizontally opposed, twin cylinder engine and the front-wheel drive employed, to use a rather conventional front suspension employing two transverse leaf springs. Movement is damped by two Houdaille vane-type hydraulic shock absorbers and rack-and-pinion steering mechanism is used.

For the new Fiat "1100" wishbones are used for the independent front wheel suspension system. The lower pair are only slightly longer than the upper pair and the coil springs which enclose the telescopic hydraulic shock absorbers are inclined at an angle that gives them a slightly progressive effect.

Threaded bearings are used for the pressed-steel wishbone members and the two widely spaced bearings for the steering swivels. The two lower wishbones are interconnected by an anti-roll torsion bar. The extreme forward position of the engine makes it possible for the worm-and-roller steering gear to be positioned behind the cylinder block of the engine. There is a divided track rod which is actuated from a central vertical rocker arm mounted in a horizontal bearing on the forward face of the bulkhead. By the adoption of this layout, the steering gear can be positioned without any particular modification on the left or right of the bulkhead, a transverse drag link connecting the drop arm to the centrally positioned rocker arm.

On the new Lancia Appia, however, the front suspension and steering are again in the traditional fashion of this make. The front suspension is accomplished by coil springs and hydraulic telescopic shock absorbers incorporated in vertical sliding units which are approximately 20½ in long. Each sliding unit is mounted on the extreme end of an I-section axle beam which is bolted to the front of the body structure. A fixed vertical pillar is clamped centrally to each end of the axle beam and the upper and lower sliding members form part of each stub axle assembly. The total movement with this type of suspension is necessarily limited, but



Lancia front suspension and steering arrangement

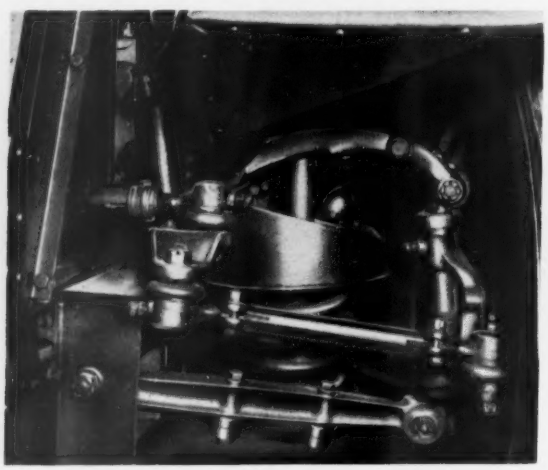
amounts in this particular instance to 3 $\frac{9}{16}$ in between the in-built rubber bump and rebound buffers, the maximum possible suspension movement being 4 $\frac{7}{16}$ in. Static deflection of the suspension is only 1$\frac{7}{8}$ in. A single-piece, forward-mounted track rod and transverse drag link in conjunction with a worm-and-sector steering gear is employed.

The front suspension of the latest Bristol 404 consists, as on the previous models, of a single transverse leaf spring, the entire assembly being attached to the two box-section longitudinal frame members by eight bolts. An anti-roll torsion bar is fitted immediately behind the cross member.

Wishbones and coil springs in conjunction with hydraulic telescopic shock absorbers are used on the new Jensen 541. Suspension members at each side are positioned on longitudinal



Torsion bar front suspension on Daimler Conquest



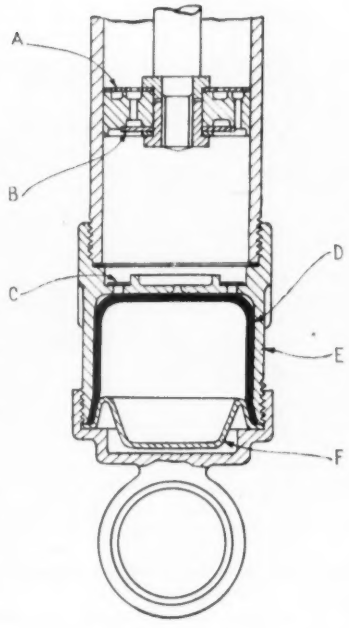
Jensen 541 front suspension arrangement

channel members of 14 S.W.G. steel which are boxed by a 16 S.W.G. plate. The lower wishbone fulcrum is rubber mounted and located within the channel section while the fulcrum point of the top wishbone is mounted on to a fabricated vertical post rising from the longitudinal channel member. The vertical posts are tied by a box-section cross member passing under the forward end of the engine.

Hydraulic double acting shock absorbers are housed within the coil springs which are positioned at their top end to the vertical posts. Steering is by a cam gear unit with the push-pull rod connected at its forward end to a bell-crank lever transmitting motion to one of the side steering rods and to the track rod which is connected at its other end to a relay lever, the steering motion being then transmitted by another side steering rod.

The new M.G. Magnette uses wishbones and coil springs for the front suspension, the upper wishbone being braced by a forwardly inclined rod against a member of the body frame structure to counteract braking reaction. The bracing rod is rubber mounted at the points of attachment. The coil spring encloses a telescopic hydraulic double-acting shock absorber, the casing of which is finned for cooling purposes. While the upper wishbone is of a conventional channel-section, pressed steel design, for the bottom link an I-section forging is used, with Metalastik bushes at the pivot points. The bottom link is braced by a rearwardly inclined strut to a location point on the body frame, in a similar manner to the upper wishbone. The lower spring pan is attached to the lower suspension link by means of two bolts, while the upper end of the spring is housed in a pan which forms the outer extension of the main structural cross member.

A rubber bump stop is attached to the lower side of this cross member and is designed to contact the bottom suspension link. The rebound check is provided by the telescopic hydraulic shock absorbers which are located at the upper end of a steel pressing rising from the centre section of the upper spring pan. A rack-and-pinion steering mechanism is bolted to the main cross member.



A. Flap valve (bump)
B. Flap valve (rebound)
C. Recuperating valve
D. Rubber air sac
E. Recuperation chamber
F. Sealing plate

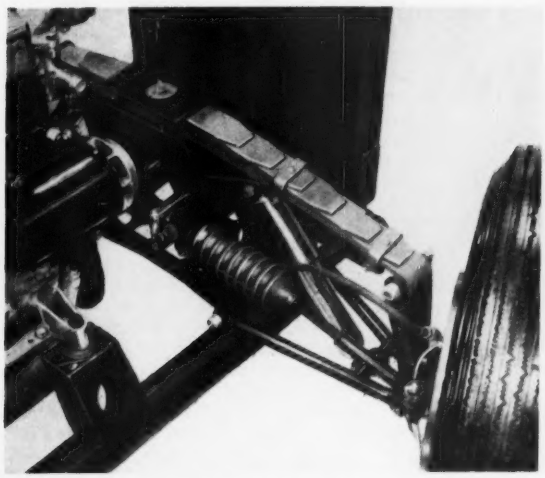
Telaflo Hi-Duty shock absorber

In introducing the new 2½-litre Pathfinder saloon, Riley again employ, as in their post-war cars, torsion bars in conjunction with wishbones for their front suspension. The upper wishbone assembly comprises two Z-section pressings with rubber bushes at both the inner and outer fulcrum points. In place of a bottom wishbone a forged lower link is used to which is attached a brake reaction strut running diagonally back to the frame where it is attached by means of rubber bushes. Both upper and lower trunnion blocks are bored and screwed to take the plain and screwed sections on each end of the swivel pin. The stub axle forging, complete with steering lever attachment lug, is pressed on to the swivel pin. A three-piece track rod and idler lever is used for the steering mechanism which is controlled by a rack-and-pinion steering gear. The steering and idling lever arms are pivoted to the centre portion of the track rod.

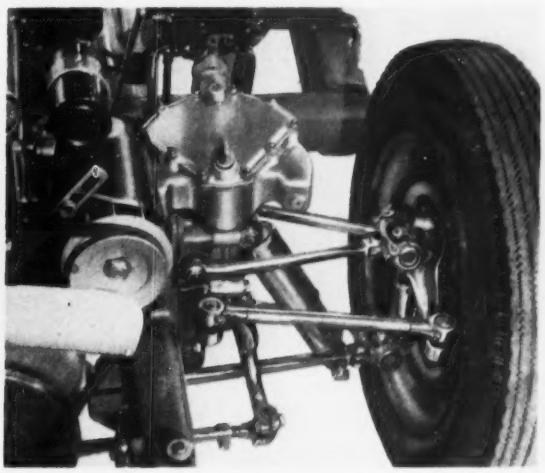
The new A.C. Ace sports car also has a rack-and-pinion steering gear. The front suspension in this vehicle is accomplished by tubular lower wishbones in conjunction with a single transverse leaf spring mounted above a fabricated triangular-shaped, box-section member, to the base of which the lower wishbones are pivoted. The complete front cross member assembly is inclined slightly from the vertical to provide the necessary castor angle. A fabricated box-section member links the end of the spring with the lower wishbone and incorporates a lug in which the kingpin is mounted. The telescopic shock absorber is positioned diagonally, with its upper end mounted on the cross member immediately below the transverse leaf spring and the lower end on a tie bar welded between the two tubular arms of the lower wishbone.

In place of the rack-and-pinion steering gear hitherto used on the post-war Jowett cars, the latest Jowett model, Jupiter R.4, is equipped with a Bishop cam-and-lever steering gear. The front superstructure of this vehicle forms part of the integral body construction and carries the independent front suspension which is accomplished in a conventional manner by wishbones and torsion bars. Telescopic shock absorbers are employed and rubber bushes are used for all suspension joints.

Two other new cars in which use is made of laminated torsion bars for the front suspension are the 2½-litre Daimler Conquest saloon and the Conquest Roadster sports car, the suspension and



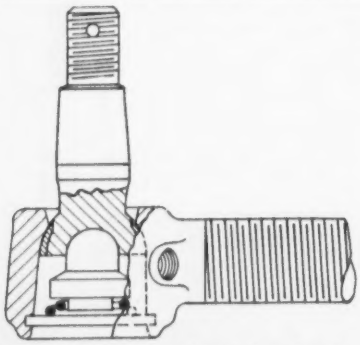
Transverse spring suspension and rack and pinion steering on A.C. Ace



Pinion and bevel steering gear on B.M.W. 501

steering layout in both cars being identical. Double transverse wishbones are fitted with telescopic shock absorbers which incorporate both the bump and rebound stops. The laminated torsion bar is formed from five leaves 0.264 in thick by 1.32 in wide and 30.125 in long. Each end of the bar is located in a square hole of a flanged cylindrical adaptor. The location flange around the rear adaptor has eighteen equally spaced fixing holes while the mounting flange of the front adaptor has twenty holes. At the rear, six $\frac{3}{8}$ in diameter bolts are used to secure the adaptor to its support bracket on the frame cruciform member, and at the front five are employed to secure the flange near the lower wishbone bearing.

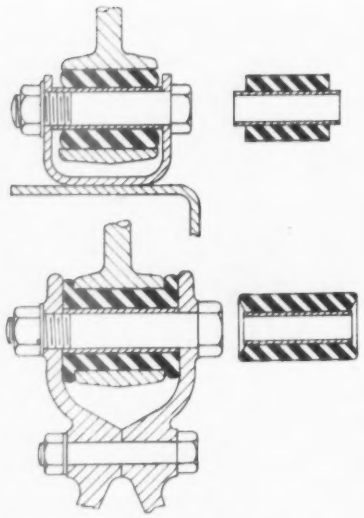
By this method of location a vernier adjustment is obtained. Rotation of both adaptors to the next adjacent fixing hole will give an adjustment equal to 2 deg, or $\frac{1}{2}$ in in terms of wheel displacement. The flanged H-section lower wishbone is in two pieces bolted together. A boss formed on each of the two inner ends carries a Metalastik cone bushing. Both inner bearings are located on a common spindle carried in flanged bosses spigoted and bolted to the inner face of each of the two vertical walls forming the front and rear of the cross member. The flange of the front end of the torsion bar adaptor mates with a flanged coupling secured on the spindle. The forged upper wishbone link is also in two pieces and bolted together. For the inner end of the upper link also, Metalastik bushes similar to those used on the lower wishbone are employed. A torsional anti-roll bar connects the two lower wishbones. The Bishop cam-and-roller steering gear is mounted immediately



Whiteley knuckle joint track rod end

behind the front cross member and operates in conjunction with a three-rod steering linkage and forward-extending steering arms.

Round torsion bars of considerable length are used for the front suspension of the B.M.W. 501, the lower wishbone link being connected through a flanged adaptor coupling to the torsion bar. Telescopic shock absorbers incorporating bound and rebound stops, are fitted. The steering gear is of the pinion-and-bevel segment type and has a reduction ratio of 16.5 : 1. A three-piece track rod system has a corresponding idling



Metalastik I.S. bushes

lever attachment at the opposite location to the steering gear.

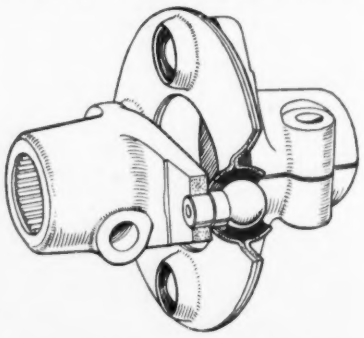
A conventional arrangement of wishbones in conjunction with coil springs and centrally mounted shock absorbers forms the front suspension system of the Mercedes Benz 180. The U-shaped box-section front cross member is fabricated from two steel pressings and apart from positioning the complete suspension units also carries the engine in two large rubber mountings. The recirculating-ball steering gear fitted on this vehicle has an automatic backlash adjustment and a hydraulic damper is incorporated in the steering linkage arrangement.

An interesting addition to proprietary suspension components is the Telaflo Hi-Duty hydraulic telescopic shock absorber. A special feature of this component is the method by which recuperation is achieved. Instead of the normal practice of using an annular space around the working cylinder, the Telaflo shock absorber has a recuperating chamber at the lower end where a special housing encloses an elastic sac which contains air at a pressure slightly above atmospheric. This sac is made of special oil-resisting plastics material to an accurate contour and size so that flexing causes very little strain in the material. On compression of the damper a volume of fluid is displaced into the recuperating chamber by a metering orifice situated centrally in the sealed end of the working chamber. This volume of fluid causes the elastic sac to be depressed, thereby compressing the air content within. Withdrawal of the piston rod necessitates the return of this volume of fluid which is forced back by the pressure within the air sac by way of a series of holes in the sealed end of the working chamber, the holes being controlled in the reverse direction by a non-return flap valve.

A track rod end employing a knuckle intermediary member developed and manufactured by Whiteley (Rishworth) Ltd. is already being fitted on several new cars. The main feature of the Whiteley track rod end is that any wear within the track rod end is evenly distributed over four surfaces, due to the fact that the ball pin turns within the spherical bearing shell, but when angular movement takes place the bearing moves in the housing. The pre-loaded spring which automatically compensates any wear, transmits its force to the ball pin through an intermediary knuckle.

Already applied to some front suspensions is the latest development of Metalastik Ltd. The I.S. (inner sleeve) bush is a compromise between the pre-loaded and bonded bush and the fully bonded bush on the other hand. In the I.S. bush the rubber sleeve is bonded only to the more highly stressed inner metal sleeve and has therefore greater load capacity than the unbonded bush. Because the I.S. bush is not bonded to an outer housing, the bush can slip under excessive torsional load without damage to the bush. Furthermore, the I.S. bush, lacking the outer metal sleeve, can be assembled direct into housings, and even in unmachined housings to a fairly wide limit. Where high axial stiffness is required, as on many suspension applications, the rubber sleeve extends beyond the inner metal tube to form a flange which is completed when the unit is finally compressed axially during assembly.

For the rack-and-pinion steering gear on the Jaguar XK.120 a Metalastik bonded rubber sandwich mounting is employed to reduce kick-back from the road wheels to the steering. This mounting has a rubber member which is $\frac{3}{8}$ in thick, $1\frac{1}{2}$ in wide and 4 in long. Fixing plates conform to the steering-



Metalastik universal steering coupling

gear base on the one side and to the chassis location point on the other.

Metalastik Ltd. also exhibited a new universal coupling, to be used, amongst other applications, between steering gears and steering columns. Designed for high torque capacity, with high torsional stiffness, this coupling accommodates angular misalignment with a minimum of resistance. It has the characteristics of a normal type of universal joint, with the exception that there are no wearing parts and no need for lubrication, since rubber-bonded ball-joints transmit the torsional movements.

REAR SUSPENSION

Few Departures from the Orthodox

ALMOST without exception, the British popular production cars are equipped with conventional semi-elliptic springs and banjo-type rear axles, but there is a marked trend towards the incorporation of certain detail refinements to obtain better riding and handling characteristics and reduce the transmission of road noise. Independent rear suspension is employed in some foreign production cars, and is favoured by certain sports car manufacturers both at home and abroad, although many use the de Dion layout. The rear suspension layouts to be found in some of the new small popular cars are of interest, but no new features have been incorporated.

For instance, in the Standard Eight, relatively wide, four leaf, semi-elliptic springs are mounted on top of the axle. Although this arrangement slightly increases the height of the rear roll centre, it enables the springs to be inclined towards the front of the vehicle, thus giving a slight understeering tendency. The motion of the rear suspension is damped by hydraulic shock absorbers mounted on the rear axle casing and connected by arms and links to the body-frame structure.

In the new Ford Anglia and Prefect, the rear suspension is also accomplished by the conventional arrangement of half elliptic springs, each composed of seven leaves. Double acting, hydraulic shock absorbers of the telescopic type are used, and they are inclined forward at an angle of approximately 45 deg. Rubber bump stops are fitted. In the new Fiat 1100 a similar layout is employed, but an anti-roll bar is fitted to both the front and rear suspension units.

Although an independent rear suspension is still incorporated in the larger Lancia cars, the new Lancia Appia has conventional semi-elliptic leaf springs mounted below the through axle. In order to give a slight understeer tendency, the axle is offset, towards the front, from the centres of the springs. The top ends of the double-acting, hydraulic shock absorbers, which are of the telescopic type, are carried by turret shaped pressings, one on each side of the vehicle, which project slightly into the front of the luggage locker. This arrangement has been made so that access may be gained to the adjustment device at the top of each damper.

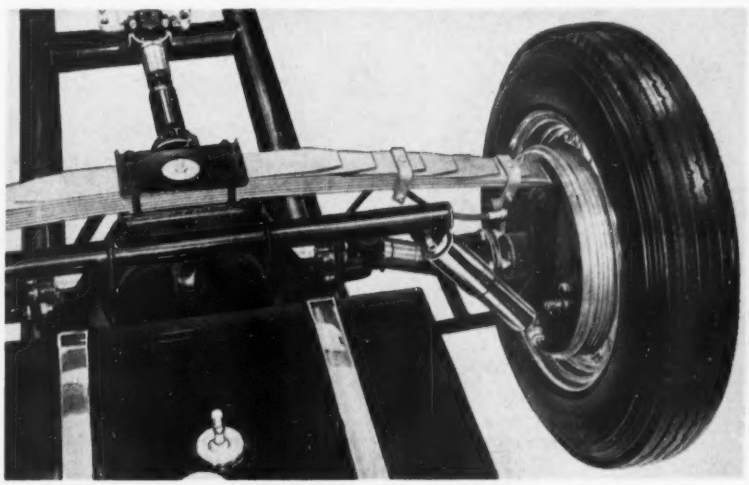
An interesting approach to the rear suspension problem is to be found in the Panhard Dyna 54 which, of course, is a front wheel driven vehicle. A broad V-shape, tubular rear axle is used and is laterally located by lugs mid-way between the two ends of the rear cross member of the central platform-like structure of the vehicle. There are trailing suspension arms on each side, and the springs are transversely mounted triple torsion bar units. Welded horizontally on top of the outer ends of the axle tube are two flat steel discs of approximately 7 in diameter, which carry a circular piece of soft rubber. On the lower face of a bracket on the frame structure directly above this is an exceptionally soft rubber bump stop of hemispherical form.

The Jowett Jupiter R4 rear suspension is of conventional form, semi-elliptic springs being now employed instead of the torsion bars and trailing arms and Panhard rod employed in the earlier sports car models. Rubber spacer pads are inserted between the ends of the leaves of the springs so that, regardless of the climatic conditions, the spring rate of 110 lb/in is maintained constant. The springs are carried on Metalastik metal-to-rubber bonded bushes. Double-acting hydraulic shock absorbers of the telescopic type are employed. The rear suspension movement from the static position to full bump is 3 in, and to the rebound position it is 4 in.

In the rear suspension of the Riley Pathfinder, the motion of the banjo-type back axle is controlled by means of two trailing radius arms and a Panhard rod. Coil springs seat on pans welded on top of the radius arms, and double acting, hydraulic shock absorbers of the telescopic type are positioned co-axially inside the coil springs. The lower ends of the shock absorbers are mounted on brackets on the lower spring pans, while the other ends are carried in turret-like pressings above the upper spring pans. These pressings are passed through the box-section frame side members. The lower portion of each telescopic shock absorber casing is finned for cooling purposes. Blocks of rubber are interposed between the axle and the radius arms, and rubber bushes are used for the pivots which are on a frame cross member adjacent to the heel board.

An unconventional feature of the suspension of the M.G. Magnette is a radius arm, which is rigidly bolted to the axle casing at a point about 3¼ in to the left of the propeller shaft axis. This arm is of I-section and is fabricated from pressed steel components. It is pivoted on a bracket, to the left of the propeller shaft tunnel, on a cross member of the body-chassis structure, the pivot point being about 7½ in in front of the axes of the spring eyes. Not only is the pivot pin of rubber, but also the bracket to which it is attached is rubber mounted on the cross member. Apart from this feature, the suspension is of conventional design with semi-elliptic springs, rubber bushed at both ends. The lower ends of the telescopic shock absorbers are finned for cooling purposes.

An independent rear suspension system is employed on the A.C. Ace. It consists of transverse, semi-elliptic springs mounted on top of a large fabricated cross member of 10 s.w.g. steel, and A-type lower transverse links. Bolts are passed through a flange round the nose piece of the final drive unit to secure it to the cross member which has a hole in it to accommodate the rear part of the axle housing. The lower transverse A-links are fabricated from steel tube, and their inner pivots are on the cross member at a point immediately above its welded junctions with the tubular side members of the frame. Steel channel sections, vertically positioned, form the hub carriers. The outer ends of the lower transverse links are pivoted on the outside of the flanges of the channels and the spring eyes between them, that is, inside the



Independent rear suspension on A.C. Ace



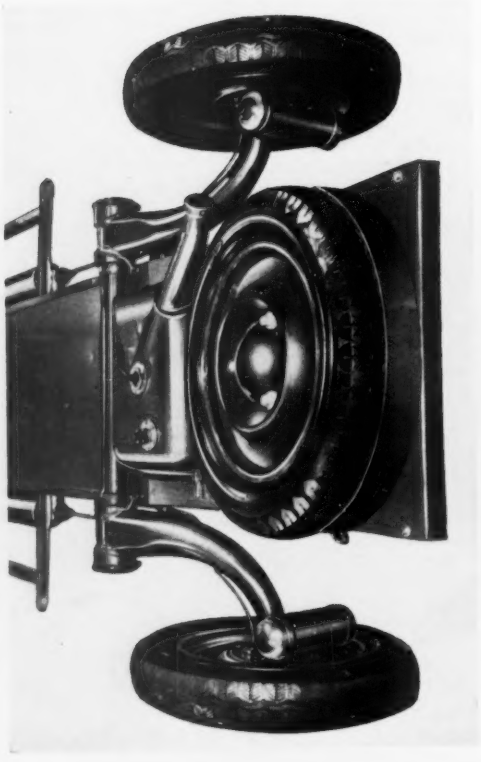
Torsion-bar suspension with through axle on B.M.W.501



Laminated torsion-bar suspension on the Volkswagen



Conventional semi-elliptic suspension on Daimler Conquest



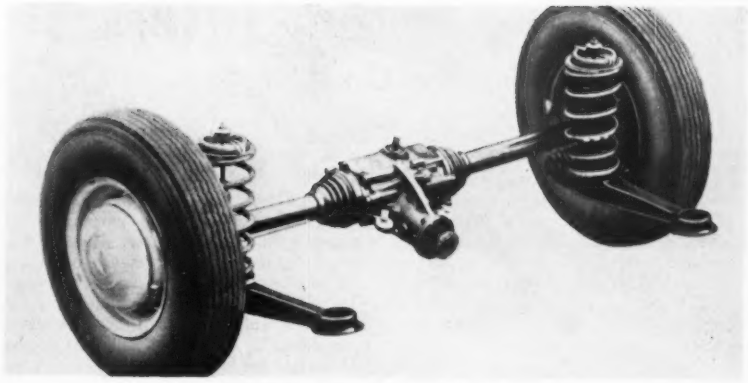
Rear suspension of the front-wheel-driven Citroen 2 C.V.

channel. Needle-roller universal joints are employed on the swinging half shafts. The lower ends of the telescopic shock absorbers are carried on the transverse A-links. They are inclined inwards at approximately 45 deg and their top ends are mounted on a tubular cross piece, attached to the rear face of the top of the cross member.

In the Daimler Conquest saloon and the Conquest Roadster, semi-elliptic leaf springs, with eleven leaves 1¾ in wide by ¼ in thick, are fitted under the axle. Telescopic shock absorbers are employed and the rebound stops are incorporated in them. The rubber bump stops are under the frame side members.

Circular section torsion bar springs are employed in conjunction with telescopic shock absorbers on the B.M.W. 501. These torsion bars are mounted just inboard of the chassis frame side members, their front ends being carried on a bracket on a frame cross member immediately behind the front wheels, and their rear ends are supported on another bracket on the frame side member where it is cranked up to pass over the rear axle. A banjo type axle is employed and the torque arm for the torsion bar on each side is attached beneath the tube near its outer ends.

Lateral location is effected by means of a triangular link, the apex of which is rubber-mounted on top of the banjo casing. The side members of this triangular bracket are of circular section bar steel and are pivoted on rubber bushes between lugs under a tubular frame cross member positioned approximately below the heel board. The geometry of the system is such that the plane in which is contained the triangular link is inclined upwards from the base of the frame cross member to the top of the axle casing. Therefore, as the suspension rises, it exerts a restraining influence and progressively increases the rate of the spring. If all the links had been solidly mounted instead of in rubber, this system would not have functioned at all, but in fact, the resilience of the rubber mountings at the ends of the torque arms under the axle tube and at all three points of the triangular link give it the flexibility necessary for its correct functioning. The bump stops are fitted underneath the frame side members and check straps, attached to the side members and passed round the axle, form the rebound stops.



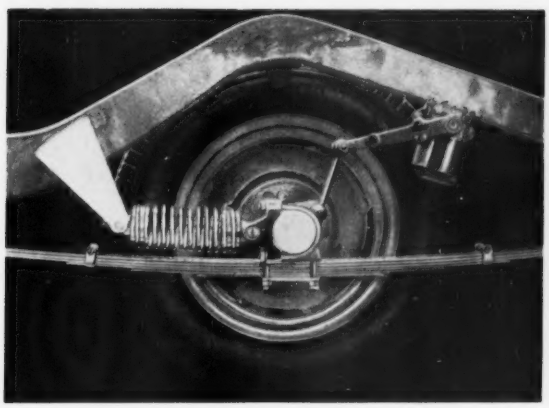
Swing-axle suspension on Mercedes-Benz 180

Mercedes-Benz have for many years incorporated swing-axle rear suspension units in their cars. In their new 180 saloon there are a number of interesting detail changes in the design. For instance, the differential housing is now suspended by a single, large rubber mounting. Furthermore, the movement of the swing axle is now restrained by trailing radius arms positioned at right angles to the axle, and pivoted on rubber mountings under the floor adjacent to the heelboard. The coil springs seat immediately in front of the rear axle on the radius arms. Telescopic shock absorbers are carried co-axially with the spring.

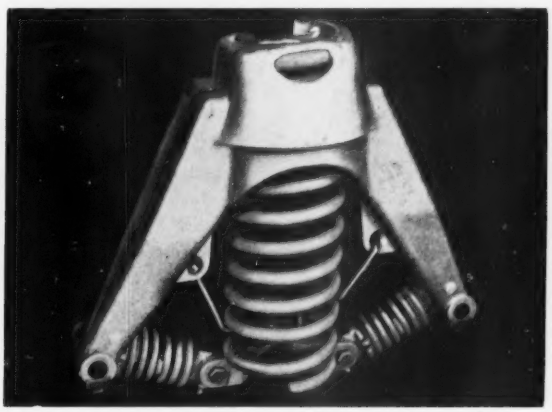
The Gregoire variable rate suspension system was exhibited by William E. Cary Ltd., but so far it has not been applied to any British production car. Nevertheless, it is widely employed on the Continent. As may be seen from the illustrations, this system may be used either with a leaf or with a coil spring layout. The main coil or leaf spring functions in the normal manner, but it is supplemented by one or by two tension coil-springs.

When the wheels are in the rebound position, the axes of these supplementary springs are more or less horizontal and perpendicular to the axle. If two springs are employed, their inner ends are attached to the axle and their outer ends to the frame, so that as the suspension rises to the full bump position, and their inner ends rise with it, they add increasingly to the spring rate as their axes are inclined more and more from the horizontal. The principle is the same when only a single spring is employed. This Gregoire layout not only gives a variable rate but also, as the load is increased, the frequency is changed much less than is the case when a more conventional system is employed.

The Silentbloc Harris Concentrated Pressure shackle is now fitted to the rear suspension units on a number of production cars, including the Standard Eight, the Ford Anglia and the Prefect. An important feature of the shackle is the domed heads of the rubber bushes which fit into concave recesses in the shackle plates. The function of these concave recesses is to prevent the rubber from spreading outwards when the bolts are tightened, and thus to compress the rubber so that tensile stresses induced by the normal function of the unit are reduced to a minimum. It is these tensile stresses which cause a form of fatigue failure of the rubber, so the life of this shackle should be greater than that of the more conventional types.



Gregoire corrector spring applied to half-elliptic leaf spring



Gregoire variable-rate coil-spring suspension unit

FRAMES

Extension of Chassisless Construction to Sports Car Design

UNIT construction bodies are now employed for many low- and medium-priced cars, and in most cases the under-floor structure resembles a chassis frame. While boxed and open channel side members, with various arrangements of cross bracing, are to be found in a large number of cars, the use of tubular side members is only resorted to on those produced in relatively small quantities. The new Ford Anglia and Prefect have basically the same integrally constructed body, except that the Anglia is a two-door and the other a four-door model. Steel pressings are employed for the full-width body structure of these cars. The floor supports, to which the front and rear suspension is attached, are of box section. The actual body floor level is below the door sills and is the lowest part of the body. Most of the panels, are bolted to the structure.

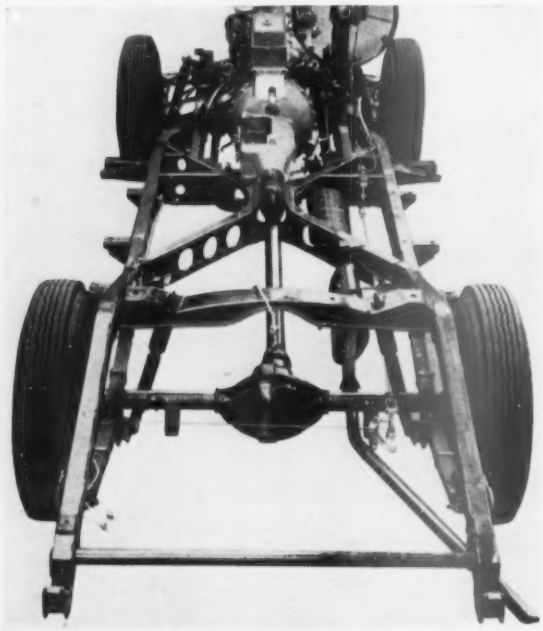
The main panels of the unit construction body of the new Standard Eight are 20 S.W.G. steel pressings and, for reinforcements and stress carrying members, 18 S.W.G. sheet is employed. Two Y-shaped side members, together with a cross member at the forward ends of their legs, form a horizontal portal frame to carry a rubber-mounted cross member on which are the front mounting points for the engine and the suspension and steering units. The arms of the Y brace the frame to a cross member welded under the front floor. Two pressed-steel struts, one on each side, extend between the centre of the Y-members and the dash.

A different approach to the chassisless design of a small car is to be found in the new Panhard Dyna 54, a description of which was in the Paris Show report published in the November 1953 issue of *Automobile Engineer*. Another solution of the problem is employed in the latest Fiat 1100 where, although the body is formed from steel pressings, a front sub-frame is used to carry the engine and gearbox as well as the front suspension, radiator and bumper. This sub-frame extends from under the front floor to almost the extreme front end of the vehicle, and it comprises two box-section longitudinal members between which are two fixed cross members, one at the front end and the other a short distance behind the fabricated box-section posts carrying the wishbone and coil spring front suspension units. The entire sub-frame is bolted at six points to the underside of the body, two of these points being at the lower end of the bracing members extending up to the dash. It is stated that in the manufacture of the vehicle, the almost completed bodies, on which the steering gear, rear axle and propeller shaft have already been fitted, are lowered on to a conveyor carrying the sub-frame, complete with the power unit and front suspension ready for assembly.

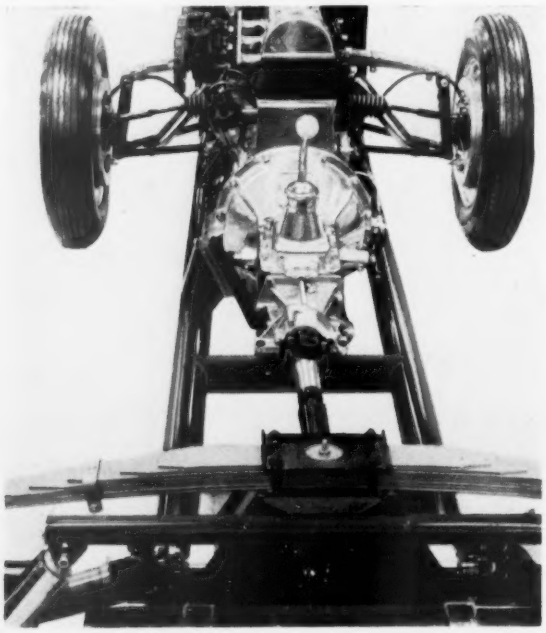
For the past thirty years, Lancia have employed unitary construction in their cars, and they have continued this tradition in their latest model, the Appia, which is a four-door pillarless saloon powered by a 1,090 cm^3 engine. The main longitudinal members of the body structure are box-section side rails immediately below the doors, but it is of interest to note that the roof, which is a single steel pressing internally reinforced, is tied structurally to the floor supports, and the scuttle and engine compartment is formed from double-skin panels which also provide the mountings for the front-suspension support cross member and the front bumper.

In the new M.G. Magnette saloon, a unitary construction in which the floor structure carries most of the loads has been adopted. Box-section extensions are welded to the front of the floor, and to these extensions are attached the main and auxiliary front cross members. Extra stiffness is afforded to the main floor section by the propeller shaft tunnel, the central cross member and the box-section side members formed by the sills. Box-section members extend back from the floor structure to provide anchorage points for the rear springs.

Interesting detail features are also to be found in the chassis frame design of other high performance cars. For instance, the frame of the new Bristol 404 is based on two main side members fabricated from 14 S.W.G. top-hat section, steel pressings which are placed on their side with closing plates welded to their flanges to form a



Cruciform bracing on the Diamler Conquest frame



Tubular chassis frame of A.C. Ace

box-section 4½ in wide and 6½ in deep. Three cross members are employed, only a single intermediate one being necessary because of the short length of the vehicle. This intermediate cross member is a 3 in diameter, drawn steel tube welded to the side members. It is some 43 in to the rear from the attachment point of the partly boxed front cross member that supports the front suspension units. This is secured by four bolts, passed through plates on each end of the side members. The main longitudinal members are only 79·4 in long. At the rear, the cross member is a massive box section, flared at each end to form a strong junction with the side members. The depth of this rear cross member is increased locally at the centre where it is divided to allow the propeller shaft to pass through. Two additional box-section members, parallel to the longitudinal axis of the frame, are welded between the intermediate and rear cross members.

The floor and propeller shaft tunnel are also welded together to form a single structure. Attached to the top of the rear cross member are the lugs that carry the A-bracket which transversely locates the rear axle. Box-section swan-neck extensions, in the side plates of which are large circular lightening holes, project back from the main longitudinal frame members to carry the rear telescopic shock absorbers.

A very sturdy chassis frame is employed in the Daimler Conquest and Conquest Roadster models, the frames in both being identical. The structure is built from box-section longitudinal side members and a channel - section cruciform brace, together with cross members of large section at the front and rear. The cranked front cross member passes below the crankcase, and carries the suspension units.

All the main members of the frame are made of 12 S.W.G. steel sheet. The box-section side members are 2¼ in wide and 5 in deep, and are fabricated from two channel section pieces welded one inside the other, so that the top and bottom walls of the section which are formed by the flanges of the channels, are double thickness.



Chassis frame of B.M.W.501

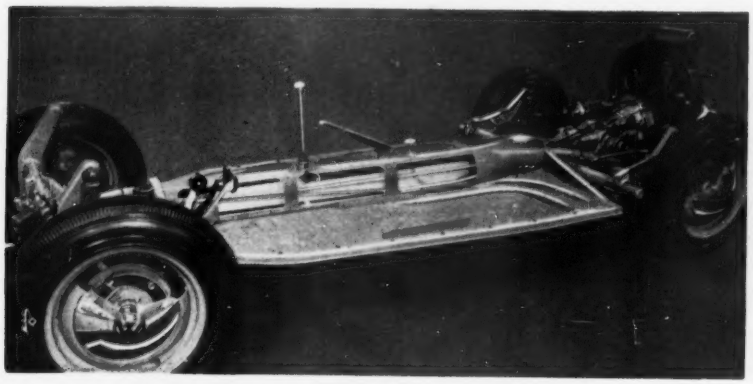
Lightening holes are incorporated extensively along the length of the inner wall of each side member, as well as in the cruciform bracing and front cross member.

In the Riley Pathfinder, a more conventional type of chassis frame is provided. It comprises two box-section side members, approximately 26 in apart at the front to clear the wheels, which are swept outwards behind the wheels so that, to the rear of the third cross member, the frame is 58½ in wide. They are then continued parallel to the rear and swept inwards again immediately in front of the fourth cross member. They then extend parallel and about 44 in apart to the rear cross member. Two additional longitudinal channel - section members extend between the front and second cross members to support the power unit.

The application of tubular side members which are straight throughout their length is exemplified in the frame of the new A.C. Ace sports car. In this vehicle, the frame design problem is simplified by the fact that transverse leaf springs and wishbones are employed for both the front and rear suspension units. The chassis frame is based on two 3 in diameter 16 S.W.G. steel tubes, which are parallel from the front to the rear. In the centre portion of the frame, a single tubular cross member is employed, and the front and rear suspension units are carried on fabricated box-section members made from 10 S.W.G. steel sheet.

In the new plastics-bodied Jowett Jupiter R4 sports car, the main frame side members are pressed steel channel sections of 16 S.W.G. boxed in by plates of the same gauge. These members are of exceptional depth and extend from front to rear of the vehicle. The front super-structure, which forms part of the integral body construction, carries the independent wishbone-type front suspension. Additional strength and stiffness is afforded by the scuttle and dash, which are an integral part of the frame structure. A tunnel accommodates the gearbox and overdrive unit and, together with the bulkhead between the boot and the rear seat squab, also forms part of the structure. There are three other cross members, in addition to the main scuttle and bulkhead structures already detailed. One of these is at the front and is steel angle section 0·125 in thick. A centre cross member carries the rear end of the overdrive and the rear ends of the torsion bars of the front suspension. The third cross member is at the rear, and supports the fuel tank.

In the past, Mercedes-Benz have generally employed chassis frames with side members made from tubes of approximately oval section, and swept out at the front and rear to receive the power unit and rear axle respectively. This type of frame is still fitted in the 300 and 300S models, but the latest model, the 180, four-door saloon with a 1·8-litre engine, has a unit construction body. The floor structure is laid out as a unit and based on a longitudinal semi-tubular member at the centre, and two box-section side members. The structural design is arranged so that the body panelling, which is partly supported by the box-section members, together with the floor structure, is equally stressed throughout. A U-shaped box-section front cross member, rubber mounted under the front end of the structure, carries the wishbone and coil spring front suspension units, the front end of the power unit and the steering box.



Platform chassis of the rear-engined Volkswagen

M

BRAKES

Further Progress in Disc Brake Design

THE results so far achieved with disc braking and a more general realization of its possibilities have largely diverted interest from developments in drum brake design. In fact, one may wonder whether present knowledge of the practical advantages gained by applying braking pressure equally to both sides of a disc is not already having the effect of lessening the incentive to improve upon results so far obtained by applying it radially outwards inside a drum.

Already experience with the few experimental examples of disc brake equipment that have been introduced has indicated the directions in which improvement lies, and has led to modifications of original designs. The recent racing success at Le Mans of the Jaguar car, to which the remarkable efficiency of its Dunlop disc brake equipment contributed, also cannot fail to have an encouraging influence upon continued efforts to eradicate known shortcomings and produce designs which can be confidently offered for general application.

One of the problems receiving attention concerns the tendency of the hydraulic fluid in application cylinders to become overheated. Others relate to the choice of the most suitable material to be used for the disc, and rapid wearing of the friction pads. There also appears to be some divergence of opinion as to the comparative merits of single and multiple brake pads and application cylinders.

Three examples of disc brakes were shown in model form at Earls Court. Of these, considerable interest was centred upon the Dunlop brake as it was of the type fitted to the Jaguar racing car. Applied to a disc of chromium-plated boiler plate, it is of extremely simple design though having three separate circular friction pads operating against each side of the disc. Of Mintex manufacture, the pads are of moulded material, 2 in diameter and about 1 in thick. They are carried in a cast light alloy caliper unit, the main central member of which embraces the disc and is held by four bolts to a plate mounting secured to the axle. The hydraulic application cylinders and pistons are incorporated in two castings mounted on the sides of the caliper and secured by two studs. The hydraulic fluid pipe from the master cylinder is connected to the inner cylinder unit and a balance tube communicates with the cylinder unit on the other side of the caliper.

Application pressure is exerted by the pistons on circular metal plates to which the outer ends of the friction pads are secured. The plates are prevented from turning by projecting tabs engaged in slots in bosses cast on the sides of the caliper. The pads are easily extracted for replacement by removing the road wheel and the cylinder units.

The latest Lockheed disc brake differs in some respects from the design introduced last year. Single segmental moulded friction pads are applied to both sides of the disc. Hydraulic pressure is exerted only on the inner pad, but slight lateral movement of the caliper unit affords compensating reaction so that the pressure is applied equally on each side of the disc.

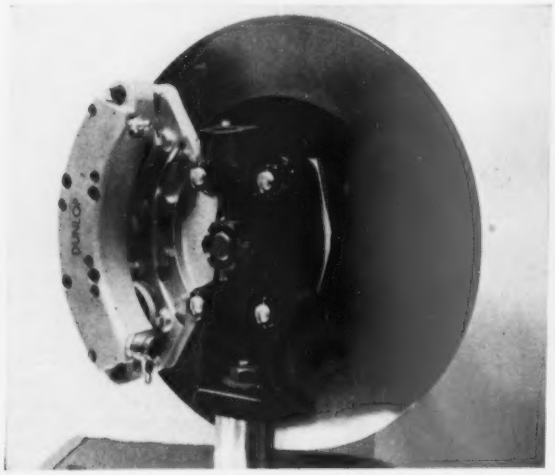
The caliper unit is of new design, being a light alloy casting, deeply ribbed on the outside to ensure rigidity and to assist air cooling. It is held by a single hexagonal bolt to a torque plate secured to the axle mounting.

Measuring approximately 4 in long, $1\frac{7}{8}$ in wide and $\frac{1}{2}$ in thick, the segmental pads provide 30 per cent greater lining area and have 70 per cent greater volume of material than those of the earlier design. The outer pad is riveted to the inside face of the caliper, and the inner one is similarly secured to a loose steel plate to which pressure is directly applied by the hydraulic piston. A small leaf spring exerts light upward pressure on the plate to prevent it from rattling. Steel end plates retain the pads in the caliper, and take the braking torque which is transmitted by way of the caliper to the torque plate. There is normally 0·005 in clearance between the pads and the disc, and a ratchet device automatically takes up the clearance as the pads wear.

The single hydraulic cylinder and piston, of about $2\frac{1}{2}$ in diameter, on the inner side of the caliper are enclosed by a steel cover plate. By releasing it from its single bolt fixing, the caliper can be detached for replacement of the friction pads. The disc is of close-grained cast iron which has been found more satisfactory in this application than hardened or chromium-plated steel. Though on the equipment exhibited the front and rear brake assemblies are mounted at the front of, and above the axle respectively, their positions are optional.

Included in the model layout is a vacuum servo unit, and the rear brake is equipped for independent application by hand lever and cable. Carried by a bracket on the axle is a housing containing a cam device whereby angular motion of a lever to which the cable is connected is converted to horizontal movement of a thrust rod. This rod applies the brake by mechanical pressure on the piston in the hydraulic cylinder. The mechanism in the housing incorporates the ratchet device which provides automatic adjustment according to the state of wear of the brake pads.

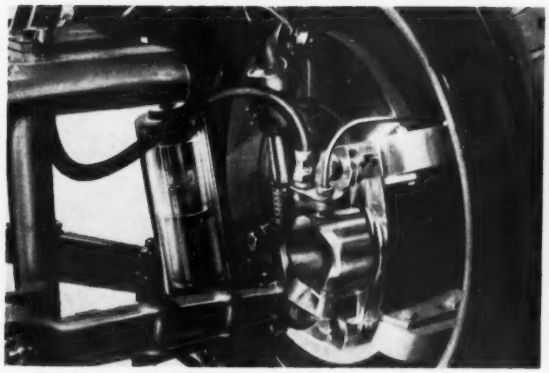
The Girling hydraulic disc brake is



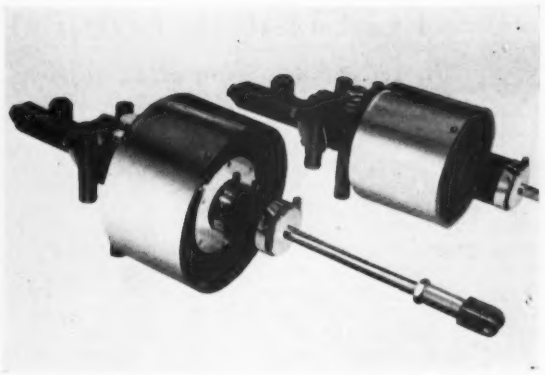
Dunlop brake for Jaguar racing car



Lockheed disc brake arranged for rear wheel application



Girling disc brake. Demonstration model with transparent plastics cylinder



In the Clayton Dewandre Concentric servo the components are in axial alignment

in the Hydrastatic class, there being no trap line pressure in the hydraulic system to act on the friction pads which are normally in only light contact with the brake disc. In the latest design, which incorporates patented features licensed from the Dunlop Rubber Co. Ltd., the previous arrangement of three hydraulic cylinders and pistons applying separate friction pads to each side of the disc has been abandoned in favour of one cylinder and piston and a single segmental pad on each side.

A light alloy caliper is held by two bolts to the axle mounting plate, and the cylinder castings are secured against sealing washers on either side. The cylinders are connected by a balance tube. About 4 in long, 2 in wide and 1 in thick, the pads are bonded to steel plates on which the pressure of the pistons is exerted. Fitted within the caliper, through which braking torque is transmitted, the pads cannot move radially inwards by reason of their segmental shape. Outward movement is prevented by two keep plates bearing against their outer edges, which are fully exposed. Accordingly, removal of the plates permits the pads to be withdrawn when required. Stops limit the movement of the pistons up to the point where renewal of the pads becomes necessary.

As the brake equipment of private cars on the British market is almost universally supplied by specialist manufacturers of hydraulic systems, there is necessarily considerable similarity among large groups of different makes and variety is mainly seen in the layouts of the control features and the hydraulic and mechanical connections to suit individual chassis. The large majority of cars have pedal-controlled hydraulic four-wheel brakes with two leading shoes for the front wheels and one leading and one trailing shoe for the rear wheels. In the smaller class are several with the hydro-mechanical alternative whereby the rear brakes are mechanically applied by both pedal and hand lever. Two trailing shoes are used for the new Girling Autostatic brake, especially intended for use on high-speed touring cars. The shoes are held in light frictional contact with the drum by light pressure in the hydraulic cylinders, the contact pressure being partially counteracted by springs adjacent to the fulcrum points. As with the Girling Hydrastatic brake, adjustment for wear is automatic and assistance is given by a Clayton Dewandre vacuum-operated booster.

Opinions differ as to the most convenient and effective position for the hand-brake lever while causing no obstruction to the driver's entry and exit. Where located beside the driving seat, it is generally pulled up from an almost horizontal position, enabling the driver to exert greater power than by pulling a vertical lever. In most cases it is seen on the outer side as is, of course, essential with bench-type front seats. The alternative position under the scuttle, usually on the outer side, appears to be widely favoured. In most instances the brake is applied by a pull-out control handle that is twisted to retain it in the on position.

Inboard mounting of the brake drums, affording the advantage of substantially reduced unsprung weight on the road wheels, is favoured by some Continental makers. As exemplified by Lancia and Pegaso, the rear-brake drums are mounted on the ends of the driving shafts where they project from the sides of the final transmission housing. Inboard mounting of the front-brake drums is seen on the front-wheel driven 2 CV Citroen. They are fitted to the drive shafts on either side of the transmission unit and, though close behind the engine, they doubtless share its cooling air as, it is understood, they do not suffer from over-heating.

Two unusual features are included in the braking equipment of the experimental Lincoln X-100 car and, it is stated, are being tested with others of a revolutionary character with the possibility of becoming available in production vehicles built by the Ford Motor Co. The front-wheel brakes are cooled by two electrically driven blowers located under the front fender. The blowers are under independent control by thermostats, and the air blasts are directed through rubber ducts to the brake drums. The hand brake, which is mechanically applied by a pull-on handle located under the scuttle, is provided with electric power assistance.

As fitted to the Jaguar Mark VII saloon, the Clayton Dewandre Vac Hydro vacuum-servo unit is fitted with a hydraulic output cylinder of a diameter that affords fluid displacement suitable for Hydrastatic braking. For vehicles equipped with other systems, requiring fluid displacement to take up brake-shoe clearances, a modified version of the servo has now been introduced. This has a hydraulic output cylinder of larger diameter, and though the displacement factor is thereby raised, the fluid pressure is lower for a given effort applied to the pedal. To obtain the same performance, therefore, the diameter of the vacuum-servo cylinder has also been increased.

A second new model has also been introduced, having the smaller output cylinder and a vacuum-servo cylinder of reduced diameter to give a performance appropriate to cars of the lighter class.

The hydraulic master cylinder of the Vac Hydro equipment is a separate unit, with pipe connection to the servo, which can be located in any convenient position on a chassis. The new Clayton Dewandre Concentric servo does not possess this advantage, which is of particular value for installation in existing chassis. Full details of its design are not yet available, but it embodies the operating principles of the Vac Hydro, and its comparative simplicity and lighter weight justify its consideration for inclusion in new car designs.

In the first place, the master cylinder and the pipe connections which the Vac Hydro requires are eliminated. Instead, the hydraulic output cylinder and vacuum-servo cylinder are in alignment with the pedal rod and are operated directly by it. The rod passes through the centre of the servo piston to actuate the servo vacuum valve and apply the pedal pressure to a sleeve which transmits it to the output cylinder. Two models of different size have been produced.

ELECTRICAL EQUIPMENT AND CAR HEATING

Increased Adoption of 12-volt Systems. Flashing Direction Indicators

IN this exhibition there were on view the first examples of American cars fitted with twelve-volt installations in place of the six-volt systems which have been the standard for so many years. The change is by no means universal but the General Motors vehicles, for instance, which are all equipped with Delco-Remy units, the Cadillac, Buick and Oldsmobile have changed over to twelve volts while the Pontiac and Chevrolet still retain their six-volt system.

In the Chrysler group there is no change and four new models exhibited, which had just been received from the U.S.A., the Chrysler New Yorker and Windsor, and the Dodge Coronet and Kingsway have six-volt equipment. The Packard also has a six-volt system. As all the imported American cars are 1953 models, it will be interesting to see whether in the 1954 types, which will be introduced at the New York Show, the twelve-volt system will be more widely adopted.

As might be expected the units comprising the twelve-volt installations are outwardly practically unchanged, since the wattage remains about the same as before. The dynamo control in the Oldsmobile allows a slight increase in output over that of the old system and it is of great interest to find that even with a current which is now comparable with that of the larger British cars, the dynamo regulator control still retains the separate current unit as before.

The Bosch equipment in the 3-litre Mercedes, which is evidently a typical example of German practice, includes a 125 mm LJ type dynamo which also has a separate current control unit so that here again the additional charge that can be given to the battery is evidently considered worth while. Another factor may be the continual demand for more current, and it is possible that the point will soon be reached when the two-unit control will no longer be adequate.

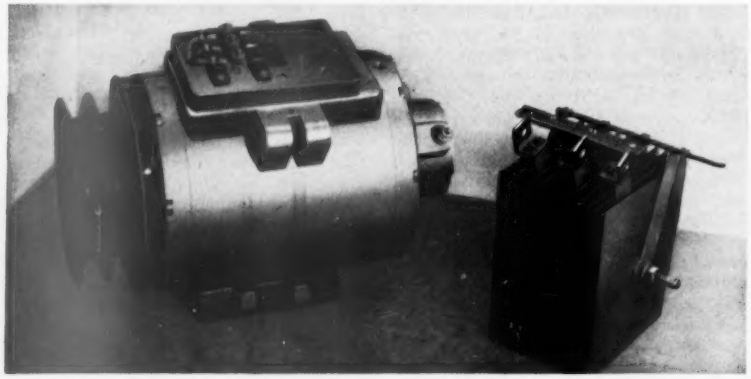
In the twelve-volt equipped American cars, the starter motor is outwardly unchanged and retains the solenoid method of engagement in which the full battery voltage is applied to the motor terminals only when the pinion is fully engaged. With the reduced current, the losses due to voltage drop should be appreciably reduced.

Ignition coils now used in American twelve-volt systems have a ballast resistance in the primary circuit in the form of a spiral coil of wire wrapped round a ceramic holder. In the Oldsmobile, the contact point gap setting is specified as 0·016 in, though the single ignition head used has an eight-lobe cam. The spark plug gap setting is 0·030 in. Because of the reduced current, contact point wear should be greatly reduced both in the contact breaker and regulator.

The Volkswagen and Porsche have the same Bosch six-volt units, the regulator being mounted on the dynamo yoke. However, in the British cars, including the small ones, twelve-volt Lucas equipment is almost universal. The degree of standardization now achieved by Lucas in their equipment is noteworthy, and is particularly marked by comparison with that observed in the European exhibits. Lucas supply two fan-cooled dynamo models, with yoke diameters of 3·9 in and 4·5 in, for the whole range of vehicles. The triangulated vee-belt drive arrangement is almost universal.

Both these dynamos are shunt-wound, two-pole machines internally cooled by an efficient fan at the driving end. They have a high output, for their size, over a wide range of speed. The compensated voltage control regulator and the cut-out units, which are mounted together, are the same for both dynamos except for the current winding in the regulator which gives to the voltage curve the required falling characteristic depending on the current, which is different in the two machines.

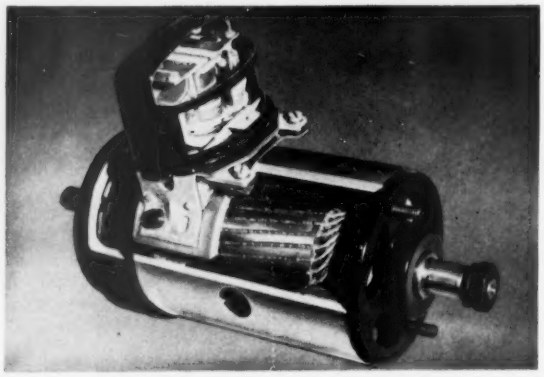
The Bosch exhibit contained three two-pole, shunt-wound dynamos internally cooled, as in the Lucas design, by a fan at the driving end. The smallest type, RED/130/6/2600,



Scintilla 1,250 watt alternator, type DDO1, and rectifier



Bosch starter for Volkswagen



Bosch 130 watt dynamo and regulator for Volkswagen

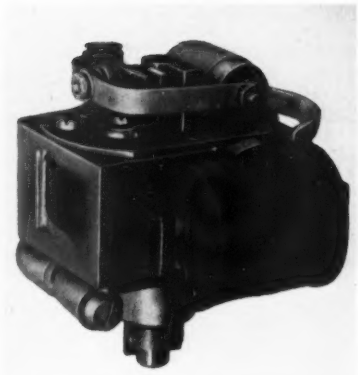
is the standard pattern fitted to the Volkswagen and Porsche. It has a yoke diameter of 90 mm, and mounted upon it is the G-type regulator, which is of small dimensions and not unlike the old F-type unit. The dynamo is a six-volt 130 watt machine. The regulator and cut-out have separate armatures, each with its own contacts, but they are operated by the same magnet. An auxiliary current-winding is provided, at one side, out of the main magnetic circuit to ensure that the cut-out contacts remain closed. The main magnet carries the voltage winding, and also the compensating coil, so that the operation is like the more usual two unit system.

The R.J.H/130/6/2200 is a similar machine having the same output of 130 watts at six volts but with a yoke diameter of 112 mm and a full output speed of 2,200 r.p.m. instead of 2,600 r.p.m. as in the former example. The LJ/G.J.M/160/12/1600 type has a yoke diameter of 112 mm and is used in conjunction with a separate control box containing the cut-out, voltage and current regulators in three units. A similar type of dynamo was fitted to the Mercedes-Benz 180, four-cylinder engine. In the Bosch method of rating, the output in watts is the maximum total load permissible, not the output of the dynamo, and is evidently adequate also to serve the battery.

There was also on view on this stand a six-pole, automatic cut-out operated by bi-metal springs. When cold, these springs make contact between the two terminals provided for each circuit, but when heated by the passage of more than the rated current of 8 amperes, the springs bend and break the circuit. A quick make and break is obtained by buckling the springs so that they open and close with a snap. The average time of contact is less than one second and the points remain open for from 10 to 20 seconds. The device can be used instead of the usual fuses in many applications.

The dynamos fitted to American cars are of Delco-Remy or Autolite manufacture and range from 35 amperes to 50 amperes at six volts, the twelve-volt machines giving about half this current. The current-voltage system of control with separate cut-out is used in all cases, the three units being mounted together as before.

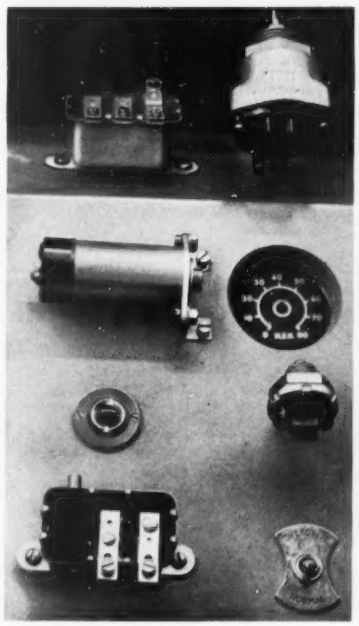
An alternating current dynamo, type DDO1, was shown with its rectifier by the Scintilla Company. The yoke diameter of the unit is approximately 7 in, and the output is 1,250 watts at 1,500 r.p.m. Both rotor and stator terminals are now grouped together on a single terminal board. The dynamo operates as a three-phase star-connected alternator, the central point being connected to earth and the other ends of each winding are connected to the appropriate terminals of the rectifier. Some of the rectified current is used to excite the rotor, and both voltage and current control are obtained as in a direct-current dynamo, though more steps are required for each regulator.



Scintilla magneto type N.F.I. R001

Two types of ignition head, the D.M.2.A.4 and the D.M.6, satisfy respectively the requirements of the British four- and six-cylinder engines. Both these models have improved bearings, and have a built-in vacuum-operated timing control connected to the contact breaker base plate which is rotated through a small angle to give part of the advance. The rest of the advance is given by the centrifugal mechanism below the plate, which controls the angular position of the ignition cam. Metallized paper, self-healing capacitors are standard, and the carbon brushes are of composite form, the material at the base having a high resistance to provide a measure of ignition interference suppression.

The combined centrifugal and vacuum control of ignition advance seems to be universally used on all cars with the exception of the American Ford and Lincoln models,



Lucas overdrive control units

which adhere to their Loadomatic system. In this design the whole angle of advance is produced by partial rotation of the contact breaker plate so that the driving shaft is in one piece, from the driving pinion or coupling to the distributor rotor. The bearings in consequence can be more widely spaced and it is claimed that the timing of the spark is more uniform. The position of the plate is controlled by a single vacuum advance unit operated by the depression at two points in the carburettor. The method of control has been fully explained in earlier issues of *Automobile Engineer* and the mechanism is substantially unchanged in the latest design.

The standard ignition coils are of two designs, the Q 12 for normal use, and the B 12 which is designed to operate with wider plug gaps and to give the correspondingly increased voltage sometimes required. For sports cars, a special coil giving a still higher performance is available.

Starting motors

Current practice as regards starter operation is very much as before. Lucas make three sizes of motors, with diameters of 4½ in, 4⅛ in and 3½ in, covering the requirements of all British production cars. In nearly all instances the battery cable is taken direct to the motor through a relay switch, mounted at some convenient point in the line, so that only the thin control lead need be taken to the starting button.

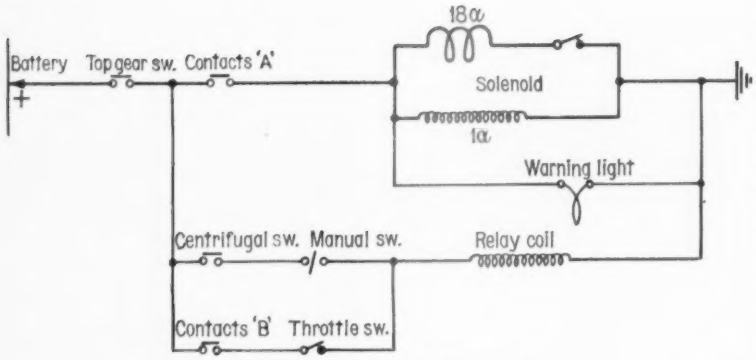
The larger American cars adhere to the solenoid method of pinion engagement and there appeared to be fewer instances in which the inertia system was used. The solenoid system used by Delco-Remy and Autolite operates as a relay switch after bringing the starter pinion into full engagement, and continues to hold it in with reduced current during starting.

Magnetos

Ranges of magnetos were shown by Bosch, Lucas, Scintilla and Wico-Pacy. The Bosch exhibit comprised four- and six-cylinder models, all of the horizontal type, with rotating magnets and having their usual design of distributor and terminal connections. Joseph Lucas Ltd. had on view only their S.R.1 and S.R.4 magnetos, which are of the rotating magnet type with pole pieces cast in the alloy metal frame. They have stationary windings and contact breaker and are designed for agricultural and industrial purposes.

The Scintilla Company showed their range of Vertex magnetos for four-, six-, eight- and twelve-cylinder engines. They also had a new small single-cylinder model No. N.F.I.R001 for single-cylinder engines, arranged for shank mounting and having a two-pole rotating magnet. No advance mechanism was fitted, but manual control could be obtained by angular movement of the magneto on its shank. The Vertex design of contact breaker was used.

A new fully-screened, horizontal



Lucas overdrive control circuit diagram

magneto type 104, for four-cylinder engines, was shown on the Wico-Pacy stand. A four-pole rotating magnet is used and the frame is of die-cast light alloy. It has cast into it the four laminated pole pieces which together with the yoke form the magnetic circuit. The coil unit, comprising the primary and secondary windings, is stationary and carried on the yoke piece which passes through it.

The distributor rotor can be carried on the end of the armature spindle beyond the contact breaker cam so that it runs at armature speed, or it can be in the usual position run on a spigot bearing with its axis offset above that of the armature, and be geared at half speed to the armature spindle. An impulse starter is incorporated and the unit can be driven either from the camshaft or the engine main shaft. The same number of sparks per revolution of the engine will be obtained in both cases if the distributor is correctly located, either on the armature spindle or offset, to run at the required speed in relation to that of the engine.

Joseph Lucas Ltd. have designed an electrical control circuit to give automatic operation of the Laycock-de Normanville overdrive units which are being fitted as an optional extra to many well-known cars. The control is automatic in action but subject to overriding control by the driver. In most installations the overdrive is operative on top gear only, but in some instances it can be used on third or, in the case of a three-speed box, second gear.

The main components of the system are a centrifugal switch, a relay and an operating solenoid. The centrifugal switch is driven at a speed proportional to the road speed of the car, and when a predetermined speed is reached, the switch contacts close. If the driver has decided to use the automatic overdrive control he will have closed a manual switch and the relay will then become energized, closing the contacts in the supply circuit to the operating solenoid. This can only happen if the car is in the appropriate gear, the selection of which causes a further switch to close in the supply circuit. The iron plunger in the solenoid will then be pulled in, lifting the operating valve in the overdrive unit which is thus brought into operation.

The operating solenoid has two windings, one of which is of low resistance and therefore of high current consumption and is the winding that causes the initial plunger movement. On reaching the limit of its stroke the plunger opens a pair of contacts so disconnecting the low resistance winding and leaving in circuit the high resistance winding to retain the plunger with only a very small current requirement.

An important feature of the circuit is an interlocking arrangement whereby, with small throttle openings at speeds below the normal centrifugal switch setting, overdrive is maintained until fast acceleration is again required. For this purpose a switch is linked mechanically to the accelerator pedal, the switch contacts being closed when the throttle is less than about one-fifth open, so that if, with overdrive engaged, the foot is lifted from the accelerator and road speed falls below that at which the centrifugal switch is operative, overdrive will remain in engagement because the throttle switch contacts, which are then closed, will provide an alternative path for the relay-coil energizing current.

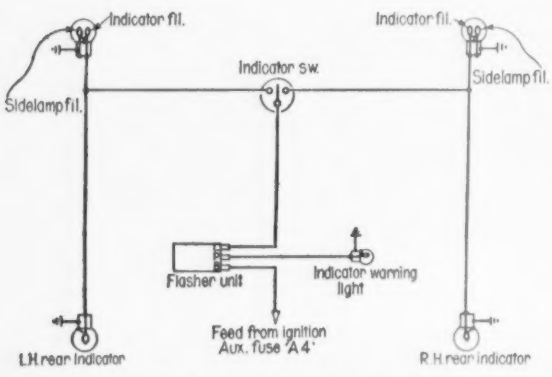
When the throttle is again opened, the throttle switch contacts open, the solenoid plunger is released and thus a return to direct gear is made until the centrifugal switch contacts close again as a result of increased road speed.

Radio interference suppression

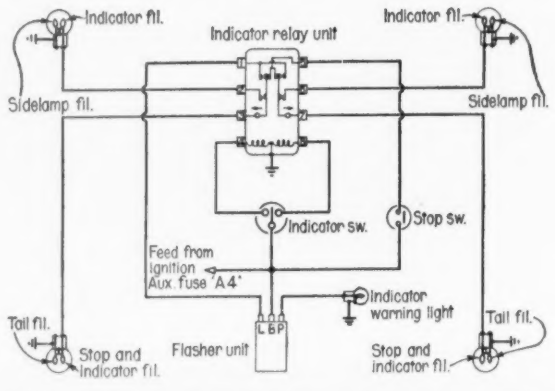
An automatically operated display unit on the Lucas stand showed the effects of unsuppressed coil ignition equipment on television reception and the improvement obtained by fitting standard suppressors, of which a full range was shown. Several other manufacturers, such as Ediswan and Ekco, also exhibited these components, and Lodge Plugs Ltd. showed a moulded terminal cap containing a resistor.

The degree of interference affecting the television waveband depends largely on the layout of the components and in many instances it is sufficient to fit a single resistance of from 10,000 to 15,000 ohms at the distributor end of the main high tension lead and possibly, in addition, a condenser of about 1·0 μF between the primary supply terminal of the coil and the frame or engine. A further measure is to incorporate resistors at each sparking plug and even in each plug lead at the distributor head. In many cars, particularly the American models, the coil is now mounted on the engine block. This arrangement has an advantage, in that any reduction in length of the high tension leads is desirable.

High-resistance plug leads are now fitted to the Pontiac and Chevrolet cars when they are received in this country, and they both then comply with the



Flashing indicator circuit, with independent rear-direction bulbs



Flashing indicator circuit, using stop-lamp filaments for rear indication

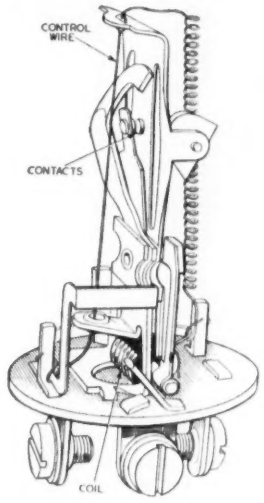
requirements of the Post Office authorities. These high-resistance leads are of conductive linen with, in the Pontiac, a resistance of 4,000 ohms per foot, and, in the Chevrolet, 8,000 ohms per foot. The Mercedes-Benz 300S is fully suppressed, even as regards the screen wiper and the regulator unit.

Lighting equipment

Considerable advances have been made both in rear and head lighting technique. The majority of British cars of recent manufacture are equipped with flush-fitting headlights located in the front wings and using the Lucas block-lens light-unit with the standard pre-focus 42/36 watt bulb. This unit, incorporated in the F 700 headlamp with double-dipping control, is considered to give an adequate performance for normal night driving. In cases where an additional range of illumination is required a new high-power lamp has been developed for fitting to certain fast cars. These lamps retain the light-unit principle but the lens design is modified and 60 watt bulbs are fitted. For general use, however, the P 700 light-unit has been introduced, and it is readily interchangeable with the F 700 standard unit. It incorporates a tripod and bulb shield and the standard 42/36 watt bulb is fitted. In addition to the SFT 700 S and SLR 700 S fog and long-range types, there are now available the new 576 twinlamps which are similar in design but slightly less than 6 in in diameter. They are also constructed on the light-unit principle, the long-range unit having a clear front lens and fitted with a 48 watt bulb.

Since over 100,000 people took their cars overseas last year, Joseph Lucas Ltd. have introduced a complete light-unit which complies with Continental lighting regulations and yet is interchangeable with the standard unit. Vertical dipping is provided and a pre-focus bulb with a shielded Duplo filament gives the dipped beam, an open filament at the focal point of the reflector giving the main beam. This arrangement is acceptable in all European countries except France, where a yellow bulb is required.

Block-pattern lens headlamp conversion sets, for home use, are available and can be fitted to most earlier car models. Each set consists of the rims, which are interchangeable, light units, double-filament pre-focus bulbs,



Lucas flasher unit

adaptors and cables. They are designed for double-dipping systems, and are to replace the old dip and switch models.

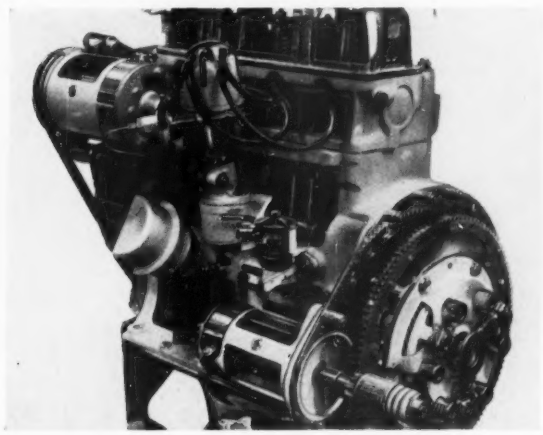
The sealed-beam headlighting system is used on all American imported cars. It differs from the Lucas light-unit in that the light source, reflector, lens and gasket are all assembled in one sealed unit so that should a filament burn out a new unit has to be fitted. Two types of sealed beam unit are available. One of these types is made entirely of hard glass and the other is a composite unit consisting of a metal reflector and glass lens. Both are completely interchangeable as regards electrical connections, beam patterns and physical dimensions. Two filaments are used, the main driving light filament being at the focal point of the reflector and the dipped filament slightly above it. Dipping is controlled by a foot switch and there is usually a small red indicator lamp which, in the case of the Oldsmobile and Cadillac, is above the speedometer face. This lights up only when the main driving beam is in use.

A current-limiting relay is part of the lighting switch on all the General Motors cars and takes the place of the fuse on British cars. Its function is to protect the lighting system from damage which might result from a short circuit. The normal lighting current is not sufficient to operate the relay, but a short circuit has the effect of making the lights flicker which they will continue to do until the fault is remedied. If a dead short occurs, the current is limited to about 18 amperes and in this case the lamps will not light.

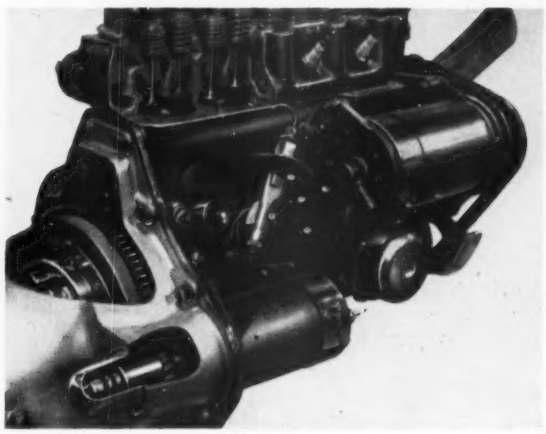
Considerable attention has recently been directed to increasing the visibility of rear lights, and the Road Transport (Rear Lights) Bill recently introduced stipulates that two rear lights, indicating the width of the vehicle, and also two reflectors are to be carried by all mechanically propelled vehicles having more than two wheels. Most cars of recent manufacture, both British and foreign, have been equipped initially with twin rear lights. On the Lucas stand were shown several new models of stop-tail lamps, which incorporate large lenses of improved optical design having increased light transmission properties over a wide angle.

The new Lucas Reflex reflectors are moulded in a red thermo-plastic material called Diakon, which is both petrol and oil-resisting. The reflecting surfaces are designed so that the spread of the reflected light is carefully controlled to produce an intense beam directed towards the source of the light.

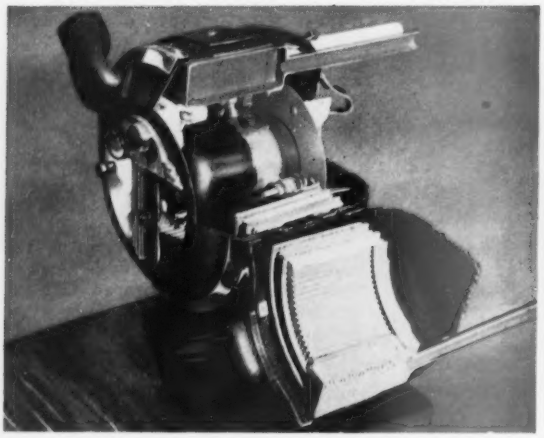
The usual American rear lamp arrangement is similar and consists of two combination tail- and stop-lights attached to ends of the rear bumper, with a number plate light in the centre. The combination stop- and tail-lamp lenses are of the Stimsonite construc-



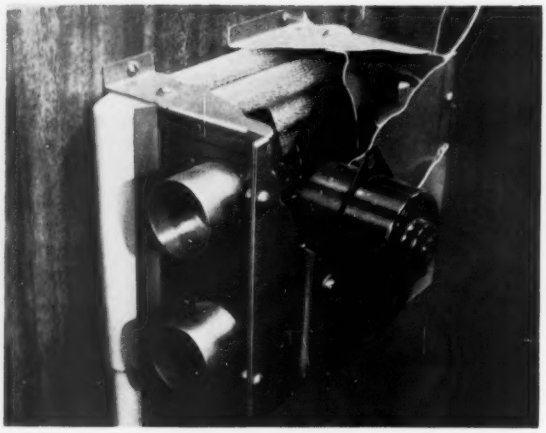
Electrical equipment on Standard 8



Arrangement of equipment on Austin A30



Delaney Gallay standard A4 heater



Clayton Dewandre S 8 heater

tion which gives a bright reflection from an approaching light. Double-filament bulbs are used.

Direction indicators of the semaphore type have been a standard fitting on British cars for a number of years, and the Minister of Transport has now also approved the flashing light system, which is favoured in America, and which hitherto has not been legal in this country. A Lucas flasher unit has been designed for this system and two circuit arrangements are suggested.

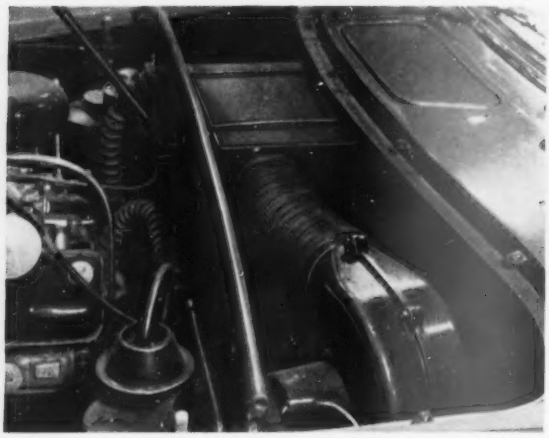
The flasher unit itself is contained in a small cylindrical metal container, one end of which is rolled over on an insulated plate carrying the mechanism and three outside terminals. The unit is operated by the linear expansion and contraction of a length of wire when heated and cooled by the intermittent passage of an electric current. This wire controls the movement of an over-centre spring blade carrying a moving contact, the action being similar to that of a quick make-and-break switch. When the direction indicator switch is turned to either right or left, current flows through the control wire and a current limiting resistance in series with it. The control wire expands linearly, as a result of the heating effect of the current, until the spring blade is allowed to snap into its alternative position, thereby closing a pair of contacts in the supply circuit to the light signals, and at the same time short-circuiting the hot wire.

The current to the light signals flows through a small coil on the base of the unit, and thus moves a plunger which closes the circuit of the panel warning light so that both light signals and warning light are illuminated together. The control wire having no current flowing through it, then cools rapidly and contracts in length pulling the spring blade back to its former position and opening the contacts to the signal and warning lights. At the same time current is again allowed to flow through the control wire so that the sequence is repeated. In this way, the direction indicating lamps as well as the panel light are caused to flash on and off about 30 times per minute. The panel warning light serves not only as an indication that the flasher unit is working correctly but also gives warning of bulb failure in any of the direction-indicator lamps, which are not in all cases visible from the driving seat. The lamps controlled by the flasher unit are the side- and stop-lights on the side to which the turn is to be made.

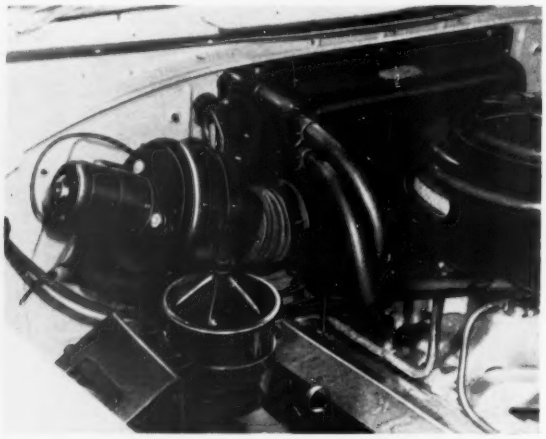
The American system gives similar results but is more rapid in action, the flashes being at the rate of 90 to 100 per minute. A bi-metal spring takes the place of the hot-wire control. It is of interest to recall a direction indicator shown at an Olympia Exhibition many years ago by the Scintilla Company. A flashing light was used in this system but there was only a single lamp on each side, mounted on the roof at its highest point so that it was visible from every direction. A powerful bulb was used and the lamp itself was of such a design that even in daylight it was visible at a considerable distance.

Heating equipment

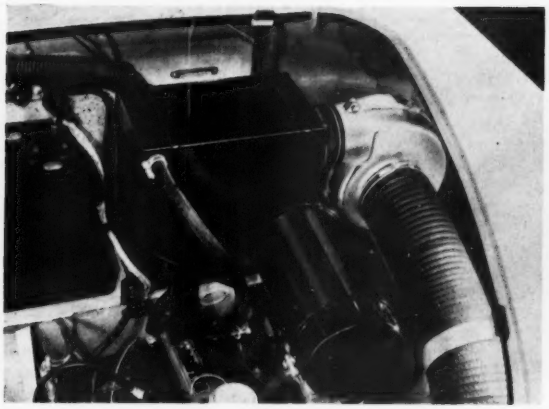
A much larger proportion of cars shown this year were fitted with heaters, and this was particularly noticeable among the smaller and lower-priced models. In the larger and more luxurious vehicles the heating installation is part of the standard equipment and included in the price, whereas in the lower-priced cars the heaters are specified as optional, and can be supplied at extra cost. For example, in the Austin range, the



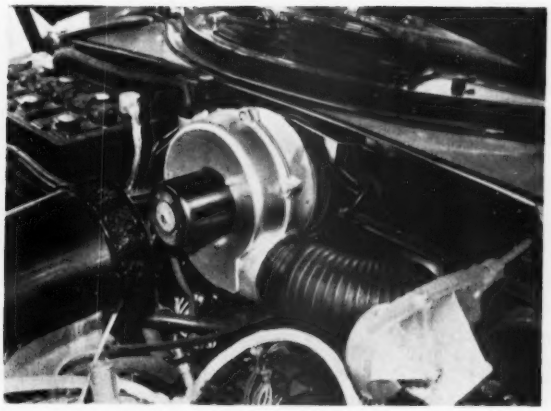
The Bristol 404 heating installation



The Dodge Coronet heating system



Special heating equipment on Austin A30



Heater on M.G. Magnette

Sheerline, Princess and Hereford have heaters as standard equipment but in the A40 and A30 they are optional extras.

In the British cars, when heaters are not standard equipment, provision is made for the installation of a particular type, the fitting of which is a comparatively simple matter, the de-misting slots being already provided. If ordered as initial equipment there is usually a price concession as the work entailed when the installation is effected on the production line is less than at a later stage.

With American cars the position is similar except that heaters are considered essential and are nearly always fitted. However, in American cars, with right-hand drive, for sale in this country, it is not always possible to fit the standard heater. This applies to the Packard, for example, in which a Delaney Gallay unit is used for de-misting, with a recirculating type heater under the front seat.

British cars are fitted with units made by Clayton Dewandre, Delaney Gallay or Smiths, quoting them in alphabetical order, who usually supply the complete equipment including the controls. The heating and ventilating system generally takes in fresh air drawn from outside the car, and heats it to serve the de-misting slots below the screen as well as the front and rear compartments of the car. Distribution is regulated by controls on the dash, which enable the car heating and screen de-misting parts of the system to be used together or independently. These controls are arranged so that in warm weather the heat may be turned off and the system used as a fresh air ventilator. The air supply is either taken through a large duct from a point near the radiator or else from the scuttle ventilator. It is passed to the heating unit, where is may or may not be passed through the heater element, and then it is distributed as required.

In the Smith system, the air goes through a centrifugal booster blower before entering the heater, giving, if the blower is switched on, a considerably increased volume of air above that provided by the ram effect arising from the forward motion of the car. The blower is controlled by a switch on the dash. The Smiths 3½ kW Series III heater incorporates a heat exchanger unit in an air-box in which are distribution valves operated from the dash. Control is effected by means of two levers working in a quadrant. One is connected by means of a flexible cable to the de-mister valve, and the other to the air valve in the heat exchanger unit and to the water valve. Usually the blower unit and the heat exchanger air-box are mounted together on the engine side of the bulkhead, and the fresh air is drawn through a large duct from the extreme front end of the car. There are many variations of this arrangement, as will be seen from the illustrations. In the M.G. Magnette and several other vehicles, the heater unit is on the body side of the bulkhead and draws its air from the scuttle ventilator. The Humber Pullman has an additional heater installed under the front seat. A small, flat, recirculating-type unit is employed and has its own motor-driven fan controlled from the dashboard.

In the Clayton Dewandre installations, the C.B. unit is fitted. It is circular in shape and has the Still heating element round its periphery. Air is drawn into the central portion which also contains the motor that drives the two fans. Both fans are enclosed and they are mounted one at each end of the electric motor.

Heaters catered for in the small British cars are of the recirculating type, with no provision for the admission of fresh air. They are circular in shape and are usually installed on the body side of the dash, as in the case of the Morris Minor. The rate of heat exchange is controlled by the speed of the electric fan, and in some cases the air flow can be directed by doors in the face of the unit.

The heating equipment on the American cars exhibited is in many cases an essential part of the vehicle; this is probably because of the severe climatic conditions of their home market. The general scheme is, however, similar to that adopted on the British cars. In the larger types such as the Cadillac and Buick, an additional unit is installed under the front seats. In most of these installations fresh air is drawn through a duct from the front of the car and delivered to the heater unit by a blower. There is also a second pipe or duct from the front which does not deliver through the heater and which gives ventilation in the hot weather.

In the Dodge Coronet illustrated, the air is admitted from the scuttle ventilator to the heater unit from which it is delivered to the de-misting slots and to the main body-heating discharge ports. Control is by three levers moving in vertical slots below the dash fascia. The left-hand slot is labelled Summer at the top and Winter at the bottom, the central slot is marked Cold and Warm, and the third, Air Ventilation.

The Dodge Kingsway has a similar system, but the fresh air is drawn through a large duct from the front of the car, and the control is by four pull-out knobs. The heating and centrifugal fan units are similar to those of the Coronet.

The Delaney Gallay A4 heater is similar to the model shown last year. The intake, through which air is drawn by a fan, is at the rear, and it can either take in fresh air from an appropriate duct arrangement or re-circulate the air in the car. Two pipes serve the de-mister slots, and the air to the body is controlled and directed by the two doors in the front. A new type, the A15, has been introduced for engines with thermosyphon circulation.

A new oil burning heater is shown on the Smith stand and is a larger version of a type previously exhibited. It has an outside diameter of 11 in and is 33 in long. This unit is designed for caravans or any similar kind of space heating applications. Operation is the same as in the smaller unit, but the temperature is automatically regulated by a thermostatic control which is adjustable. The heating chamber is concentric with the outer casing and there is no connection between it and the ventilating air chamber so that the air being heated for supply purposes cannot be contaminated by any fumes from the burner.

COACHWORK

Weight Reduction by Unitary Construction or Wider Use of Light-Alloys

EACH Motor Exhibition can be relied upon to produce a number of ideas that demand close investigation, and it has been noticeable that since the war most of the ideas that have attracted attention were to be found on the stands of specialist coachbuilders. This year the stands occupied by car manufacturers were of more than passing interest, for with the approach to more normal trading conditions these concerns have found it necessary to attract purchasers by offering novel devices on their new models.

Amongst the trends that could be detected, it is evident that chassis manufacturers do not consider that steering-column gear control is an absolute necessity. It was noticed that some of the new chassis retained the central gear change which, in the case of the Rover, is elevated to permit three persons to be accommodated without discomfort on the front seat.

In the new Riley, a right-hand gear change is adopted, this representing a reversion to the traditional arrangement for gear operation, and in the position used by the Riley Company, a small cut-away is made in the seat cushion, enabling the lever to be positioned clear of the space needed for the driver to enter the car. Whilst such a feature is really a matter that concerns the chassis engineer, it has of course its effect on the body designer who, with the steering-column arrangement that has grown in favour in the past few years, finds that the comfort of the front seat passengers has been greatly facilitated.

Another point noticed was that wing spats are no longer considered to be essential, and it would appear that both coachbuilder and car manufacturer are testing the feeling of the market in this respect. The new Riley, for example, has a completely visible rear wheel, and amongst the coachbuilders' stands it was seen that Park Ward have omitted this feature on one of their new bodies.

Among the bodies exhibited by specialist coachbuilders, there did not on this occasion appear to be any outstandingly new design, possibly because no ultra-modern chassis capable of carrying such coachwork has appeared during the past twelve months. There were, of course, the usual number of bodies of good line and finish, but whereas the previous exhibition produced coachwork on the then new Continental Bentley, no chassis of similar calibre was available to them for this exhibition.

Certain changes have been made to the Rolls-Royce Silver Wraith chassis which carried many bodies in the coachwork section, and a worth-while increase of 7 in in wheel base has permitted a corresponding increase in the seating and luggage compartments. This long-wheelbase chassis is now the only Rolls-Royce Silver Wraith model that is produced, and another modification that has made an appearance on these cars is the movement of the radiator, which is now positioned 4 in further forward. At the same time the rearward end of the bonnet has been widened to suit the current trend for wider bodies.

Much technical interest was aroused by the several new cars exhibited by car manufacturers and it is interesting to record the technique that producers have adopted to achieve both light weight and low selling prices. These today are two most important features and the question of weight reduction is one to which all car and body producers pay considerable attention.

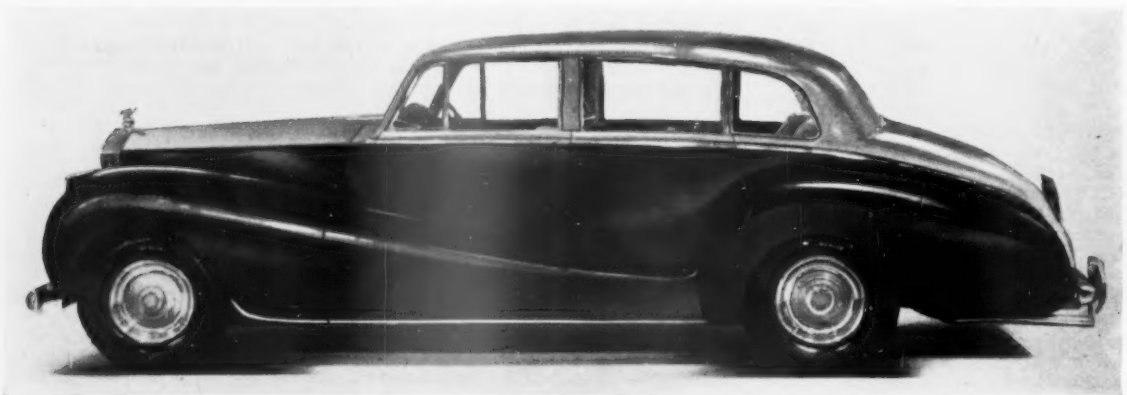
Dealing first with the entirely new cars and paying particular attention to the smaller, economy models, a prominent place must be accorded the new Standard Eight. This, like several other new small cars, is of unitary construction, the body shell in effect replacing the conventional chassis frame. The body is composed of 20 gauge steel pressings with 18 gauge reinforcements at points where additional strength is required, for example, where fixings are needed for such items as hinges and locks. The front bulkhead plays a very important part in creating a rigid forward unit and by distributing the loading, stress concentration at the front end is avoided.

The bulkhead structure is supplemented by two Y-shaped sub-frames that are attached to a cross member in line with the windscreen, and these are triangulated by pressings extended from the scuttle and, with the inner wing valances, provide valuable stress-resisting units.

Concerning the design of the body itself, it follows the modern line with the front wings carried through to the rear at waist height, the overall width of the car diminishing towards the rear but having slightly protruding rear wing panels to produce an overall width at this point approximately equivalent to the width over the front wings. The bonnet is of the conventional alligator-pattern and the radiator grille or inlet for cooling air is low down on the front panel, as also are the side lights.

Particular attention has been devoted to the question of luggage accommodation and beneath the rear boot floor is located the petrol tank and spare wheel housing. To supplement the luggage that can be accommodated within the body, the rear seat is so arranged that both cushion and squab can be folded forwards to rest against the backs of the two front seats, thus leaving the rear seat pan area free for luggage disposal, the folded seat protecting the trimming on the backs of the front seats from damage by loosely packed luggage.

Any new model announced by the Ford Motor Company arouses much interest and this was the case with the new Anglia and Prefect models. Again unitary construction has been used. The compact proportions of the two new Ford cars give, perhaps, the impression that interior room has been



Well-balanced lines characterize this Rolls-Royce saloon by Park Ward

sacrificed, but this is not the case and undoubtedly the use of small diameter wheels has done much to simplify the problems of engine and luggage accommodation, both of which have a a very distinct bearing on internal dimensions.

Both of the new bodies are of four-light style, the Anglia being a two-door and the Prefect a four-door. Here again, the front wings are carried through to the rear, giving completely flush-side panel effect, the depth being relieved by a swaging extending rearwards from the head lamps.

It may be remembered that at the last exhibition there was a distinct tendency for chassis manufacturers to rearrange the position of the petrol tank, and it is therefore interesting to note that on both the new Ford models the tank is located above and to the rear of the near-side rear wheel arch. This greatly facilitates luggage disposal and is largely responsible for the convenience with which cases can be arranged in the luggage boot which, in conformity with modern practice, has a top-hinged lid. Both new Ford models are equipped with bonnets that are hinged at their forward ends, the locking handle being situated beneath the scuttle.

Another interesting new car is the M.G. Magnette, and this also represents another excellent example of unitary construction, the body floor forming the main stress-carrying unit. At the front end of the floor and bulkhead unit, box-section members are attached by welding and carry the front suspension and power unit. Being a low car with rear-wheel drive, a central tunnel is necessary in the floor member and this, together with a central cross member and the box section sills, forms an extremely rigid component. At the rear end, box-section members extend to provide anchorage points for the rear springs.

In connection with this new M.G. model it is of interest to note that the major body pressings are the same as those used for one of the Wolseley models, produced by an associated company. Mainly due to the low overall height that has been achieved, this standardization, however, is not immediately apparent. It was noticed, too, that this model in common with other new models is not fitted with wing spats, neither is any attempt made to create a deep wing to partly conceal the rear wheel. There is a well-curved screen, set at a sharp angle, and all doors close on their rearward edges.



The unitary method of construction is adopted for the M.G. Magnette

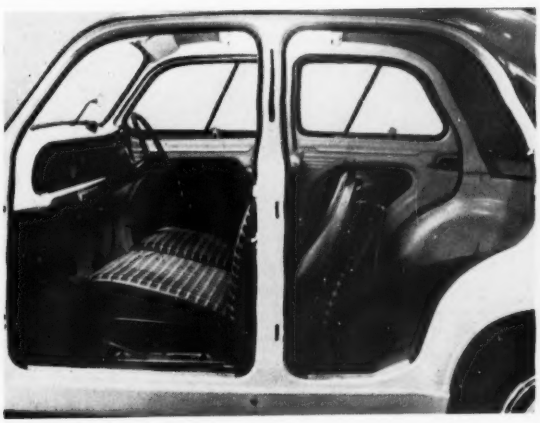
On another M.G. model, the smaller Midget sports two-seater, a feature that appeals is the leather-covered, foam-latex roll arranged along the back edge of the scuttle, thus cushioning a hard edge that might cause injury to a passenger in the event of a minor collision. A similar feature has been seen on some American cars.

Mention has already been made of the fact that there is a tendency for rear wing spats to be eliminated, and in addition to the examples already mentioned, another newcomer following the same procedure is the Riley Pathfinder. This entirely new model is built in traditional style with a separate chassis frame, and the sporting-type, four-door, four-light body follows modern clean-sided style, with downswept bonnet and boot panels. To achieve a low overall height, the floor is sunk below the frame side members and there is a tunnel over the propeller shaft and also over the gearbox.

Particularly interesting on this car is the fact that a right-hand change-speed lever has been adopted, and this is one of the very few cars now using this form of control. A bench-type front seat is used and the facia board arrangement is interesting, instruments being grouped immediately in front of the driver where they are clearly visible through the two-spoked steering wheel. A projecting portion of the cabinet work above the instruments prevents reflection of the instrument lights by the inclined windscreen. The radio speaker unit is, therefore, situated in the centre of the facia and there is a capacious locker with a hinged lid on the near side.

A new range of bodies has been introduced on the three-litre Lagonda chassis, and all the bodies exhibited were by Tickford. The saloon is notable for its well balanced lines. The metal-framed door tops give an impression of lightness that does much to enhance the appearance.

Amongst the varied body styles offered by specialist coachbuilders, there was to be seen the usual high standard of finish and the devotion to styling that has become associated with the products of the coachbuilders in



On the Standard Eight the rear seat may be folded to provide extra luggage accommodation



Interior of the Carbodies convertible on a Ford Consul



Modern styling of the new Riley Pathfinder

this country. The past few years have shown that coachbuilders have been fully aware of the need to adopt constructional methods that will achieve a reduction in weight, and light alloy materials are finding increasing use.

To the larger coachbuilders, any major change in the design of the more expensive chassis is a matter of some importance, as most of their activities are centred around these chassis. This year, for example, the Rolls-Royce Silver Wraith is available in one form only, corresponding to the long-wheelbase chassis of last year, and it has therefore been possible to increase the length, both in the seating compartment and in the luggage boot, and both these features have been welcomed by coachbuilders.

Particularly outstanding was the touring limousine shown by H. J. Mulliner & Co. Ltd. and, apart from its excellent appearance, this body fully demonstrated the manner in which the coachbuilder long associated with traditional methods of construction has benefited from experience both during and since the war in the manipulation of light-alloy materials. The kerbside weight of this touring limousine, which is capable of seating five or six passengers, is a few pounds over 42 cwt, and this can be regarded as a major achievement for a car of this size. The light-alloy construction used for the framing of this body, which is panelled in aluminium, is very similar, however, in many respects to that used for the Bentley Continental saloon that, when introduced last year, carried a body by the same coachbuilder.

The Mulliner limousine is fitted with four doors that are all hung on concealed hinges, the front doors being hinged on their forward pillars, whilst the rear doors to give better entrance, are hinged at the rear. This coachbuilder has for some years used push-button locks of his own design and construction.

The limousine has an electrically operated division glass which can be controlled both from the front or rear compartment. The cabinet work on the division is well arranged, with a central cabinet and folding tables at each side, whilst the rear compartment, that is trimmed in impeccable style, is complete with foot rests. The driving seat is adjustable for leg reach and both front door windows and quarter windows have a portion that is arranged to swivel.

The increase in body length has been of considerable assistance in the planning of luggage accommodation, which is reached through a rear door hinged on its upper edge. A small feature that adds to the clean external appearance is the elimination of external locking handles for the bonnet, the coachbuilder having devised an arrangement that is operated from beneath the scuttle.

In common with many other coachbuilders, H. J. Mulliner has adopted the flashing-type direction indicator which not only gives a less broken panel surface but also is more readily serviced than the earlier semaphore type.

A second H. J. Mulliner exhibit on a Rolls-Royce Silver Wraith chassis was a seven-passenger enclosed limousine. This four-door body accommodates seven passengers arranged with two on forward-facing occasional seats, accommodation of three on the front seats being rather hampered by the position of the Rolls-Royce steering column, the position of which remains unaltered despite the wider bodies now being fitted. The capacious luggage boot is fitted with a door that is hinged at the bottom and can be made to form an additional luggage platform, a separate door being arranged to exclude dust.

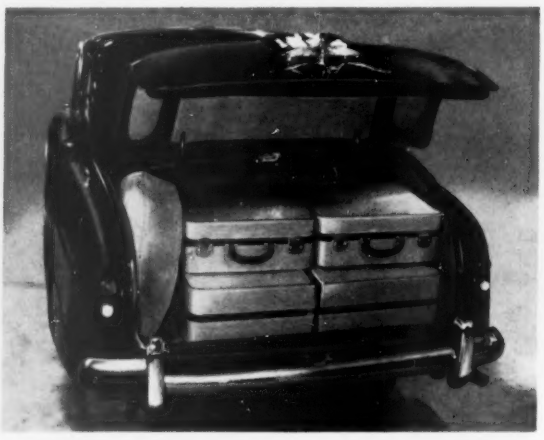
This coachbuilder's display was completed by two Bentley chassis, one of which was of the Continental sports type that created so much interest last year. This design is virtually unchanged and the same remarks can be applied to the four-door, six-light saloon coachwork carried by the other Bentley. Both bodies, of course, are of light-alloy construction and are panelled in aluminium.

Another outstanding design on the latest Rolls-Royce chassis was exhibited by Park Ward & Co. Ltd., and this body could scarcely fail to attract attention wherever it was seen. Finished in a dual-colour scheme of green and metallic grey, it is outstanding for its long swept front wing line which falls as it passes across the two side doors to blend into the rear wing line at a point low down on the rear door panel.

Of its many outstanding features, one that attracted considerable attention is the luggage boot with its large lid hinged at the top. This discloses a compartment with a capacity of 14 ft.^{3} As exhibited, this luggage storage space



Luggage accommodation on this Park Ward-bodied Rolls-Royce is particularly good



A James Young Continental Bentley saloon has a vertical spare wheel mounting

was occupied by a number of suitcases, of such dimensions that the utmost use is made of the available space.

Below the boot floor there is of course the usual petrol tank and in the available space behind the tank, Park Ward have arranged a compartment for road tools. This cavity, when closed by its easily removable trap-door, offers no obstruction to luggage disposal.

For the construction of this body Park Ward have used their patented method to form a framework of steel which is covered with aluminium panels. The four doors are hung on concealed hinges, which in each case are carried by the forward pillars. Seating accommodation is provided for five persons, including the driver. The interior is trimmed in pale grey leather.

The Park Ward method of construction is also used for a seven-passenger enclosed limousine on a Rolls-Royce Silver Wraith chassis and the conventional seating arrangement of two on the front seat, two on occasional seats and three on the rear seat is used. This limousine body has a luggage boot that incorporates a dust flap and platform for additional luggage, and in the furnishing of the interior the radio controls and other fitments are recessed into the rear side arm rests. The centre division cabinet houses cocktail fittings and the curved division window is electrically operated. The trimming of the front seat is carried out in tan leather, and for the rear compartment fawn West of England cloth is used.

Another interesting body shown by Park Ward, a four-light drop-head coupé on a Rolls-Royce Silver Dawn also constructed on the all-steel principle, provides seating accommodation for four persons. The rear wings are integral with the body and a commodious luggage locker—which also houses the spare wheel—is provided at the rear. On this body the folding head mechanism is power-operated and the head links are concealed by an inner cloth lining. This head is equipped with a particularly large rear window that gives excellent vision.



Touring limousine by H. J. Mulliner on a Rolls-Royce Silver Wraith

It is very evident that coachbuilders in general have given particular thought to the question of luggage accommodation, and another outstanding body in this respect was a four-door sports saloon on a Bentley chassis shown by James Young Ltd. In the case of this particular body, it is interesting to note that the builders have ignored the conventional Bentley spare wheel arrangement and have instead placed the spare wheel in an approximately vertical position against the near-side wheel arch. There is much to be said for this spare-wheel arrangement which facilitates removal when the boot is fully loaded, and it is to be hoped that a similar layout will be adopted by other coachbuilders.

In the construction of this pleasing James Young body, light alloy plays a prominent part in the formation of the body framework, steel reinforcements being introduced wherever additional strength is required. The body is panelled in aluminium and no sunshine roof is used. Although in most respects this is a normal Bentley chassis, the coachbuilders concerned have adopted the Continental radiator shell, which is mounted in a more forward position than that normally used.

The revised bonnet cowling is well suited to the front wing design that has been adopted and the nose of each front wing contains the standard pattern of integral head lamp beneath which is a grille decorating the cool air inlet.

All four doors on this body are arranged to close on the rearward pillars,



Well-planned interior of the Rolls-Royce limousine by H. J. Mulliner



Pleasing interior devised by Freestone and Webb on a Rolls-Royce touring saloon



Freestone and Webb-bodied Rolls-Royce touring limousine

concealed hinges being used. The use of light metal frames for the construction of the doors above the waist line gives a very pleasing and light effect. All windows are arranged to drop, being operated by winding mechanisms, and each door is equipped with a swivelling glass panel for ventilation purposes. Press-button locks are used and the chromium-plated waist moulding incorporates fixed outside handle grips.

The seating layout provides a bench-type front seat incorporating two intermediate arm rests, and also rug rails for the use of the rear seat passengers. Armrests are arranged on the front doors. The instrument panel, which houses the standard equipment at one side, has in the centre a large oval loudspeaker, all woodwork being carried out in polished veneered walnut. The interior trimming is in pleated and bolster style, with plain top cushions in leather, and each door is trimmed to accommodate slip pockets, the front doors in addition having spacious lockers with sliding shutters. For the convenience of the rear seat passengers, the interior quarters carry spring-return arm-pulls.

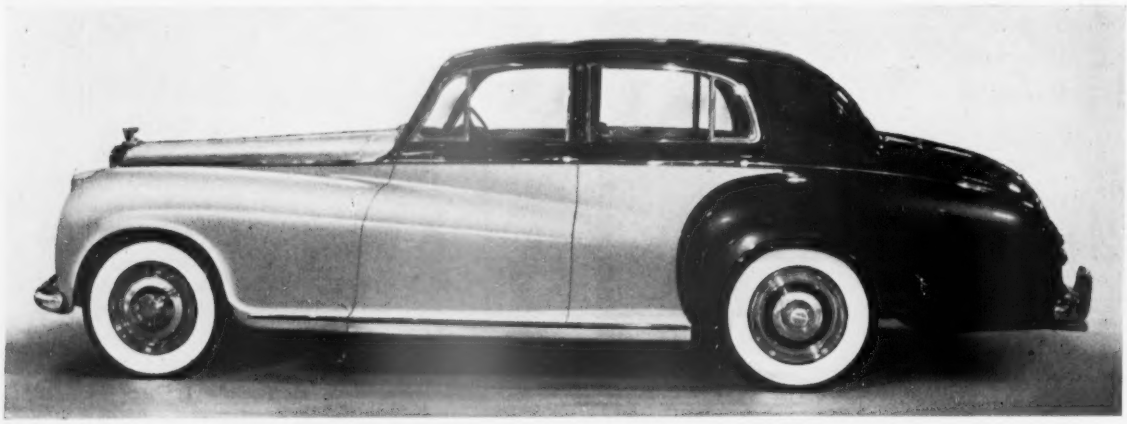
The closed car with, perhaps, the most outstanding appearance in the exhibition was the two-seater coupé exhibited by Hooper & Co. (Coachbuilders) Ltd. on a special series Daimler chassis. It will be noted from the illustration of this striking-looking car that in comparison with the total length of the vehicle, the roof panels cover only a small area, and since the designer was concerned only with comfort for two front-seat occupants, it was possible to carry the roof line downwards with a sharp sweep to merge into the well-swept tail panels. Furthermore, since the question of luggage capacity was not a primary factor, it was unnecessary to maintain good height for the rear panels. In the result, there has been created a pleasing, well-balanced design that, however limited might be the demand, cannot fail to attract favourable comment wherever it is seen. Since there is ample space within the body and only two front seats were required, the excess space behind the seats is occupied by two suitcases.

In the construction of the body the Hooper light-weight system utilizing aluminium alloy is employed and the wide door which carries an extension of the front wing, is hinged on its forward edge. The spare wheel is carried in a cradle below the boot floor and may be lowered to facilitate extraction of the spare wheel when required. On the near side of the instrument board is a shallow sliding tray fitted with a hinge-over mirror and containing a silver powder compact, cigarette case, lighter, and clothes brush. Another point of note is that the roof contains a Sundym glass panel which can, when required, be covered by a shutter.

This coachbuilder also exhibited a touring limousine on a Rolls-Royce Silver Wraith chassis, and following the style used by Hooper in the past, the body width towards the rear is such that there are no obvious rear wings. Normally this body has no occasional seats but, if required, one of the two flush-folding tables at the rear of the division can be replaced by a small sideway-folding occasional seat.

The coachwork exhibited by Freestone and Webb Ltd. can always be relied upon to produce favourable comment on the subject of interior furnishing, and this was certainly true of the cars displayed at the recent exhibition. One of these was a special sports saloon on a Bentley chassis, the body being of four-door, four-light style having seating accommodation for six persons. The front seat is of the split-bench type fitted with winding adjustment for the rake of the squab. A bolster style of trimming is used and contrasting piping gives a pleasing effect. Folding picnic tables are built into the rear of the front seat squabs and there are self-adjusting mirrors. Particular attention has been devoted to the design of the windscreen which, to promote good visibility, has light-section pillars and is also curved. There is, in addition, an extremely large back-light and the care which has been devoted to both forward and rearward visibility creates a distinct feeling of driving comfort. Ample luggage accommodation is provided in the rear boot which extends to the full width of the coachwork.

Another outstanding exhibit was the Freestone and Webb four-door six-light body on a Rolls-Royce Silver Wraith chassis. This closed car has a division and provides accommodation for six or seven persons, the front and rear seats being of the one-piece type. Two occasional seats are fitted in the rear compartment and these, when folded, provide foot rests for the rear passengers.



Pleasing wing lines and modified radiator on the Bentley saloon by James Young

An interesting point is that the roof above the rear compartment is fitted with a Perspex panel which has an inner sliding shutter. All interior woodwork, of excellent workmanship, is in highly polished walnut, and into the rear of the division are built two folding picnic tables, together with centre cabinet housing cocktail requisites.

A body which is of particular interest since externally it appears to be a normal sports saloon but can, in fact, be converted into a vehicle capable of carrying a considerable quantity of luggage, was the Countryman sports saloon shown by Harold Radford & Co. Ltd. on a Bentley chassis. In the arrangement of the interior, the rear seats are devised to fold forwards independently, providing a clear floor space above the rear axle. To make the best use of this luggage space, special provision has been made for gaining access from the rear, and not only can the boot lid be folded downwards to carry additional luggage, but the upper central panel containing the back-light may be elevated. This Countryman body is very well equipped and contains sliding cocktail cabinets in the rear quarters, whilst occasional tables are fitted to the rear of the front seats, which embody adjustable mirrors.

The interesting Bentley two-door sports saloon, which was a feature of the stand occupied by E. D. Abbott Ltd. last year, was again to be found amongst the exhibits staged by this coachbuilder. Only small modifications have been made to this design which now has less curvature on the roof, a small change that has been effected by slightly reducing the headroom. This reduction has not had any detrimental effect on passenger comfort. It may be remembered that this design was amongst those which last year provided means for accommodating a considerable quantity of luggage, the rear-seat squab being devised to hinge forwards in which position it created open access between the luggage boot and the rear compartment seat pan.



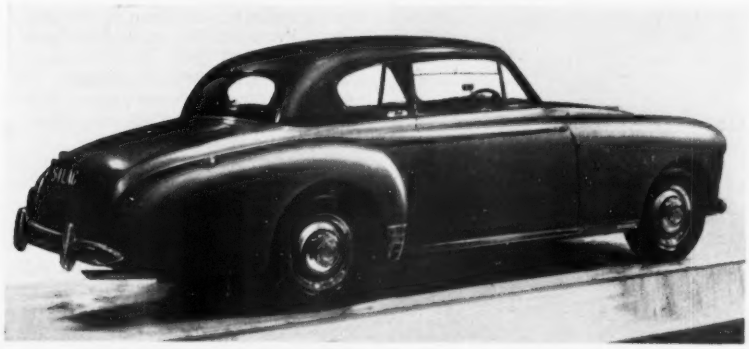
Clean lines characterize the Bristol sports coupé by E. D. Abbott Ltd.

A second exhibit was a carefully planned aerodynamic sports coupé design mounted on a Bristol 2-litre chassis. This body was notable for its mounting of the smoothly contoured bonnet and front cowl panels which are hinged at the forward end, and when elevated, give complete and easy access to the power unit. This entire bonnet and cowl unit is constructed on tubular steel framework subsequently panelled in aluminium. Although light, the bonnet when raised is counterbalanced by a spring ram located horizontally on the right-hand side of the engine. Behind the seats there is a light-weight hinged decking that is raised to reveal a recess into which the Turzog-covered head is folded.

Normally this chassis embodies a large tank to utilize the space available at the rear end of the frame, but E. D. Abbott Ltd. have arranged a petrol tank in each rear wing. The interior is trimmed in black leather and carpet to avoid any possible reflections, and this thought is followed in the arrangement of the instruments, which are hooded.



An attractive two-seater coupé by Hooper on a special Daimler chassis



Ample luggage space is a feature of this Tickford-bodied Lagonda

Bodies on the Lagonda Mark II chassis were shown by Tickford Ltd., one being a two-door sports saloon and the other a two-door coupé. Both are bodies of excellent line and the saloon has a composite framework of ash strengthened where desirable, with steel plates, and a steel sub-frame is used. The scuttle and windscreen pillars are panelled in steel, the remainder of the body being panelled in 16 gauge aluminium. Panels and sub-frame are treated with sound-deadening compound. The front ends and outer halves of the rear wings are detachable and the doors are each carried on three large concealed hinges. For the front seats, which are independently adjustable, tubular steel is used and these have hinged backs to facilitate entry to the rear seats, the hinging being arranged off-centre to give still further room. Both windscreen and rear window are in curved laminated glass and the windscreen is fixed.

The drophead body exhibited by Tickford Ltd. is equipped with the three-position head mechanism developed by this coachbuilder and the external covering of the head is in Melloroid P.V.C. material. There is a large rear window which is carried in a chromium-plated frame and the interior of the head is lined in cloth. As is usual with convertible coachwork, special attention has been devoted to the design

and construction of the scuttle and much strength is gained through the use of steel for the screen pillars and the employment of steel for the scuttle panelling.

Amongst those coachbuilders who have achieved a reputation for producing bodywork at a competitive figure for the motor trade is Mulliners Ltd., who this year exhibited bodies on certain new chassis. A model which is unchanged in appearance but which has certain new features is the Aston Martin DB2 model, which carries a two-door, four-light saloon body of all-metal construction.

The body constructional methods are new, and consist of a combination of aluminium alloy, tubular and pressed steel members, covered with stout gauge aluminium panelling. The bonnet and front wings are built as a single unit and hinged at the front to throw forwards, thus giving easy access to the engine and front suspension details. The curved windscreen is fixed and is fitted with two-speed windscreen wipers, the windscreen equipment including screen washers and de-misting components. The back light has double curvature and is contained in the lid giving access to the luggage compartment, this lid being hinged upwards when access is required and has a lock which is controlled by an interior handle located in front of the right-hand wheel arch.

The Sunbeam Alpine, two-seater sports, with coachwork by Mulliners, was exhibited for the first time, and this two-door body is of all-steel construction. There is a detachable windscreen with side deflectors and the folding head contains a rear window panel that may be folded down for additional ventilation. Sliding plastic side screens are mounted in detachable frames and a leather roll is arranged round the cockpit and facia which, on the passenger's side contains a convenient grab-rail. The spare wheel is housed below the luggage locker. Small tools are in a special case which is conveniently stowed under the scuttle.

A type of body that is attracting increasing attention, is the hard-top coupé, and that shown by Thrupp and Maberly Ltd. on a Hillman, represents an excellent example. This two-door, all-steel body has been designed to promote clear all-round vision and not only is there an exceptionally wide rear light embracing also the rear roof corners, but the side windows, which when dropped completely disappear into the lower panels, are not divided by an upper central pillar.



The A.C. sports two-seater has well-swept lines

The two wide doors are hung on concealed hinges and are provided with pivoting ventilation panels at their forward ends. A full-width adjustable front seat has a centrally divided squab giving easy access to the rear compartment from either side of the car. This car is attractively finished in a dual-colour scheme of cream and black.

This coachbuilder also exhibited an excellent type of limousine body on a Mark IV Humber Pullman chassis. This is a type of body that has for some time been associated with the name of Thrupp and Maberly for it provides all the convenience and comfort of a limousine style at a reasonable cost. Accommodation is provided for eight persons, including the driver, both the rear and occasional seats being sufficiently wide to seat three persons. The rear seat has fixed side and folding centre arm rests and the electrically operated division window is curved.

To summarize the impressions of the coachwork exhibits and also of the coachwork shown by chassis manufacturers, it is very evident that one feature that has received considerable thought is the question of luggage accommodation. The ideas that were to be found at the previous exhibition have gained further adherents, and it is to be noted that more cars are being produced in which the rear seat squab folds forwards and in some cases the entire seat is arranged to fold and rest against the front seat backs.

There has been a further extension of the repositioned petrol tank scheme, and a location that has been adopted by a coachbuilder consists of separate petrol tanks in the rearward portions of the rear wings. The new Ford Prefect and Anglia models have their petrol tanks at the near side of the boot.

The spare wheel is still a problem and where the petrol tank is beneath the boot floor it is difficult to position the spare wheel between the extreme ends of the frame side members. Thus many specialized bodies were to be found with the spare wheel placed on the floor of the boot where it impedes access and causes considerable trouble when the spare wheel is needed and the boot fully occupied by luggage. It is noticed, however, that there is a move to accommodate the spare wheel in a vertical position at the side of the boot. This idea should be pursued.

Of constructional methods, there has been a welcome extension in the use of light alloy with the result that bodies are lighter and there is a consequent improvement in car performance. The unitary method of construction is found more frequently and this, too, shows a worth-while saving in weight.

The impression is gained that steering column gear control mechanism is less popular and although this is a matter that primarily concerns the chassis technician, it does have its effect on the coachbuilder who has found that without having to worry about a central gear lever, or in some cases a side gear lever, the seating of three passengers on a bench-type front seat has been quite easy to arrange.



Good visibility is a feature of the Hillman California model



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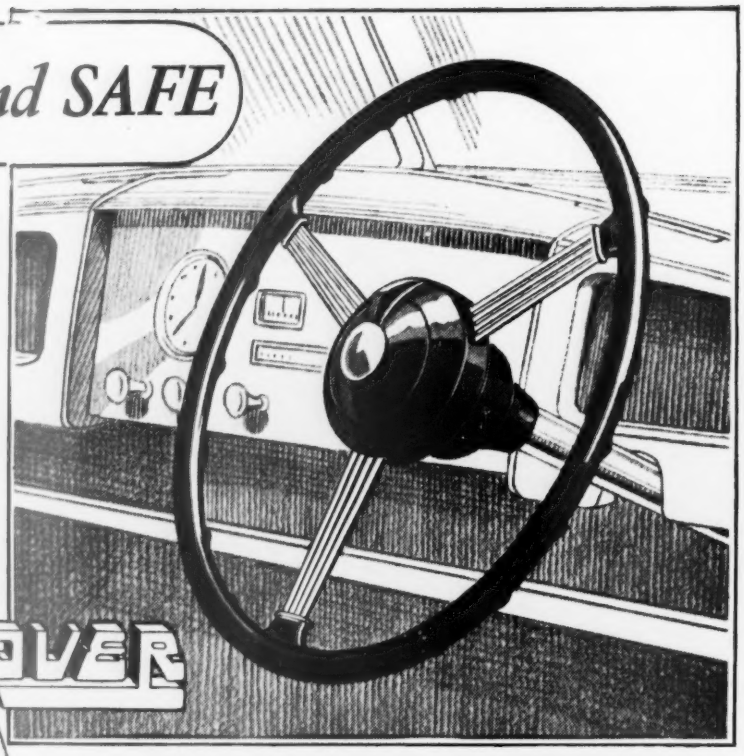
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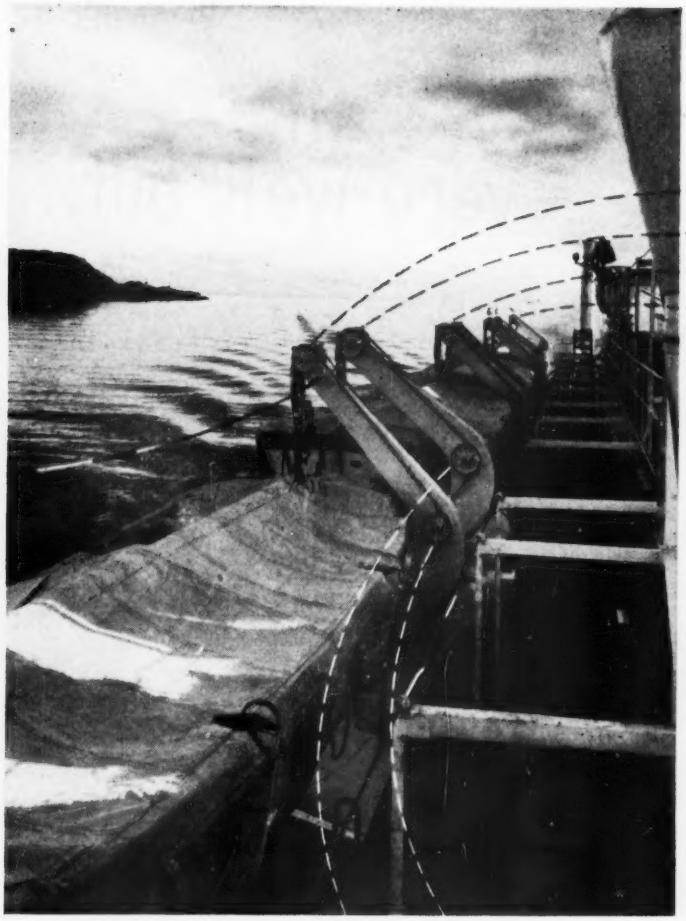
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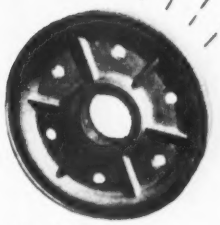
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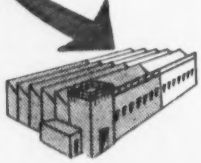
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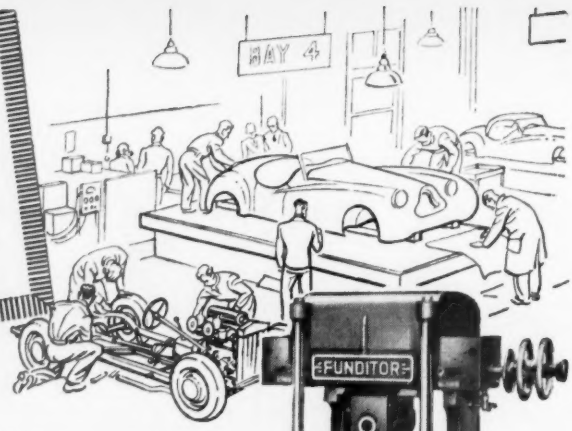
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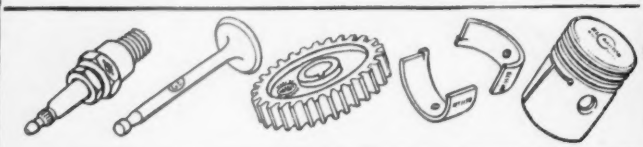
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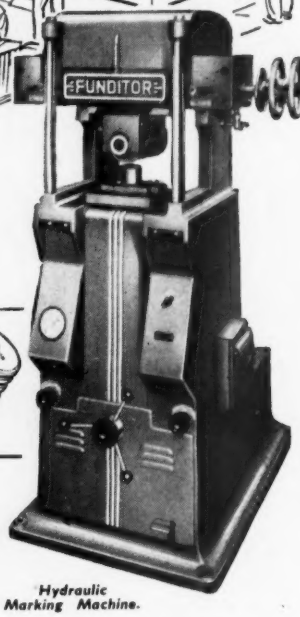


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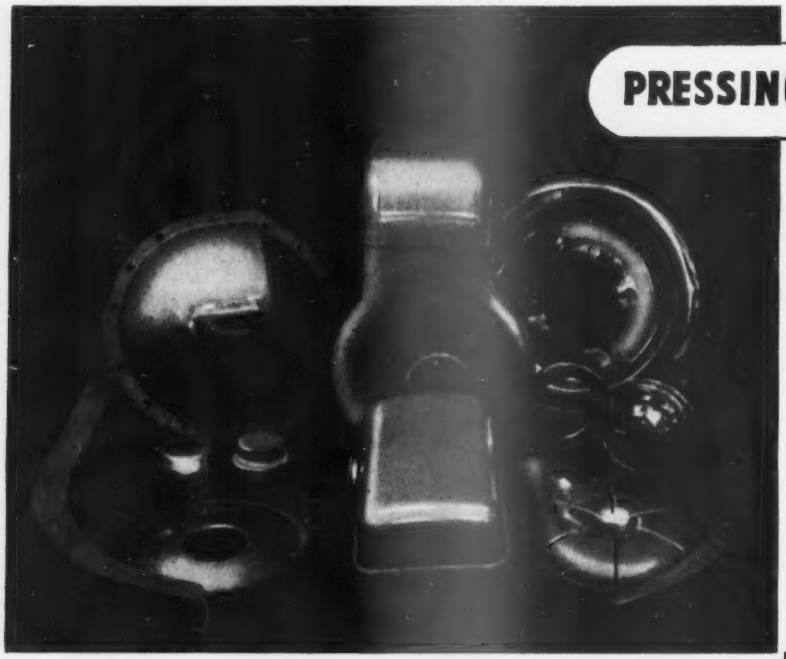


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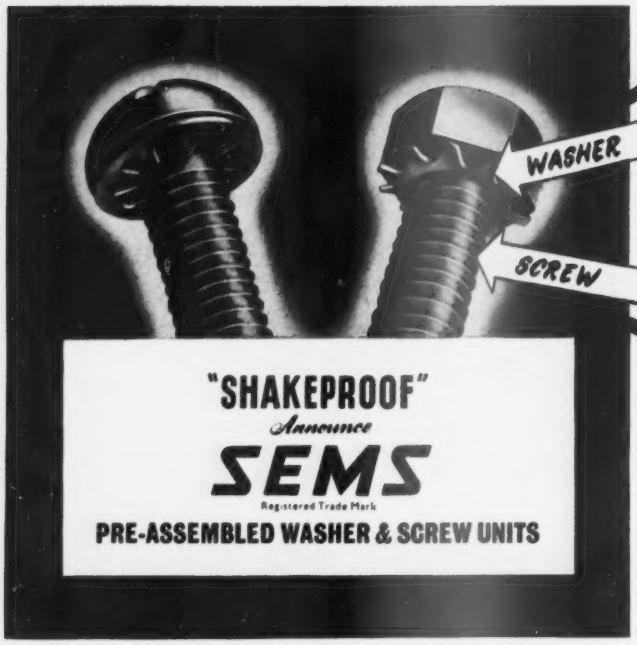
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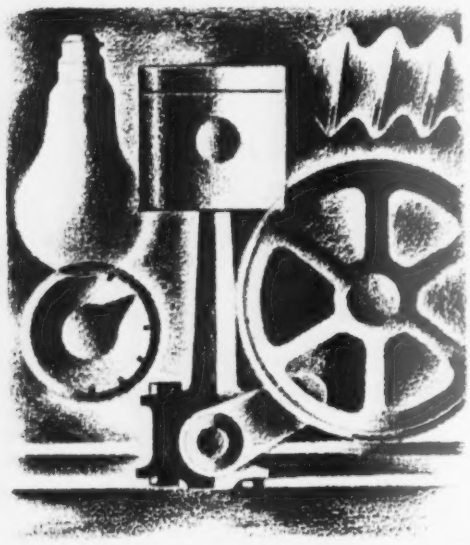
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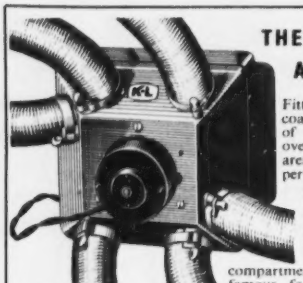
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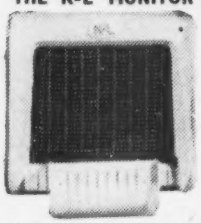




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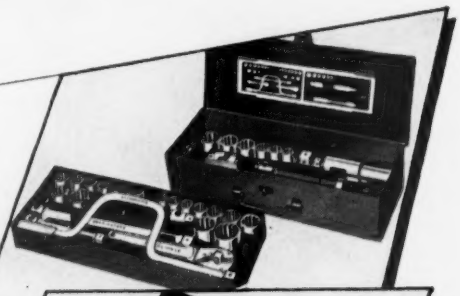
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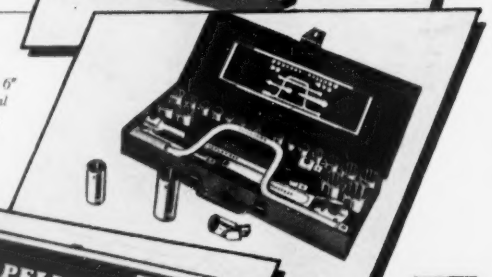
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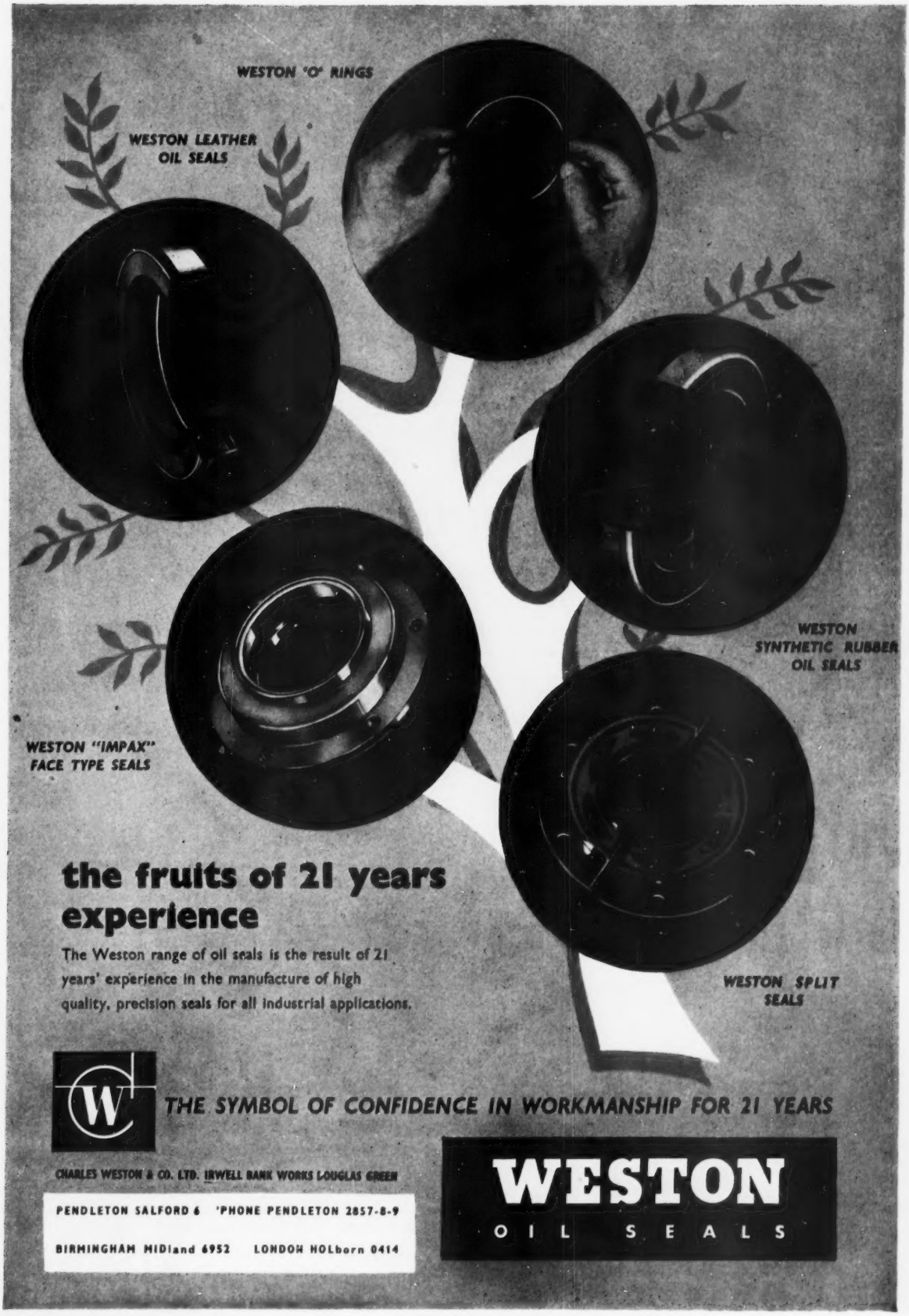
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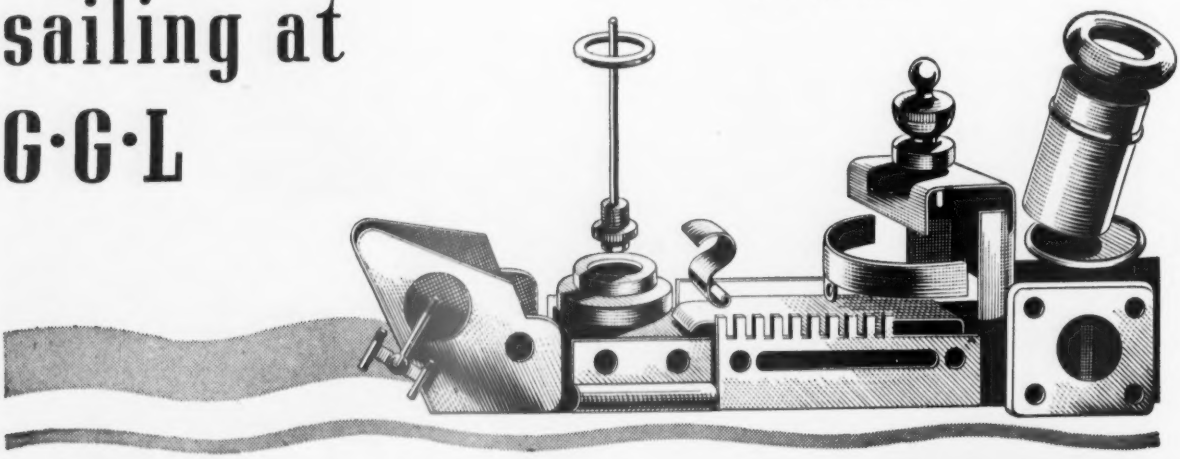
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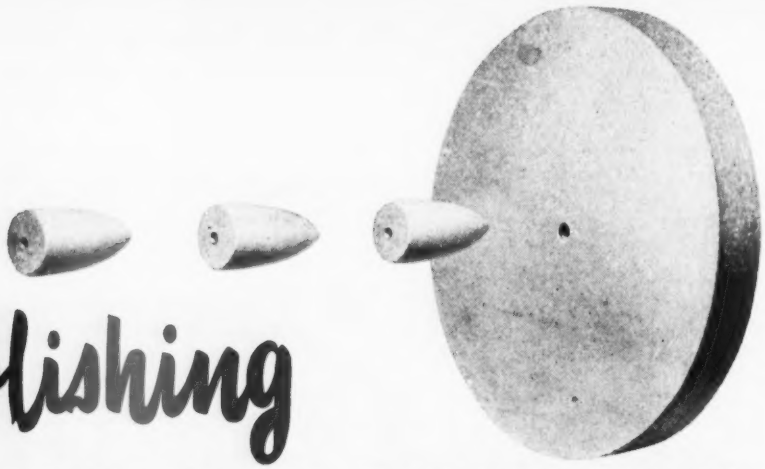
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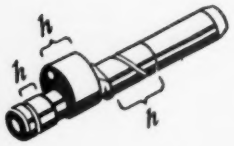
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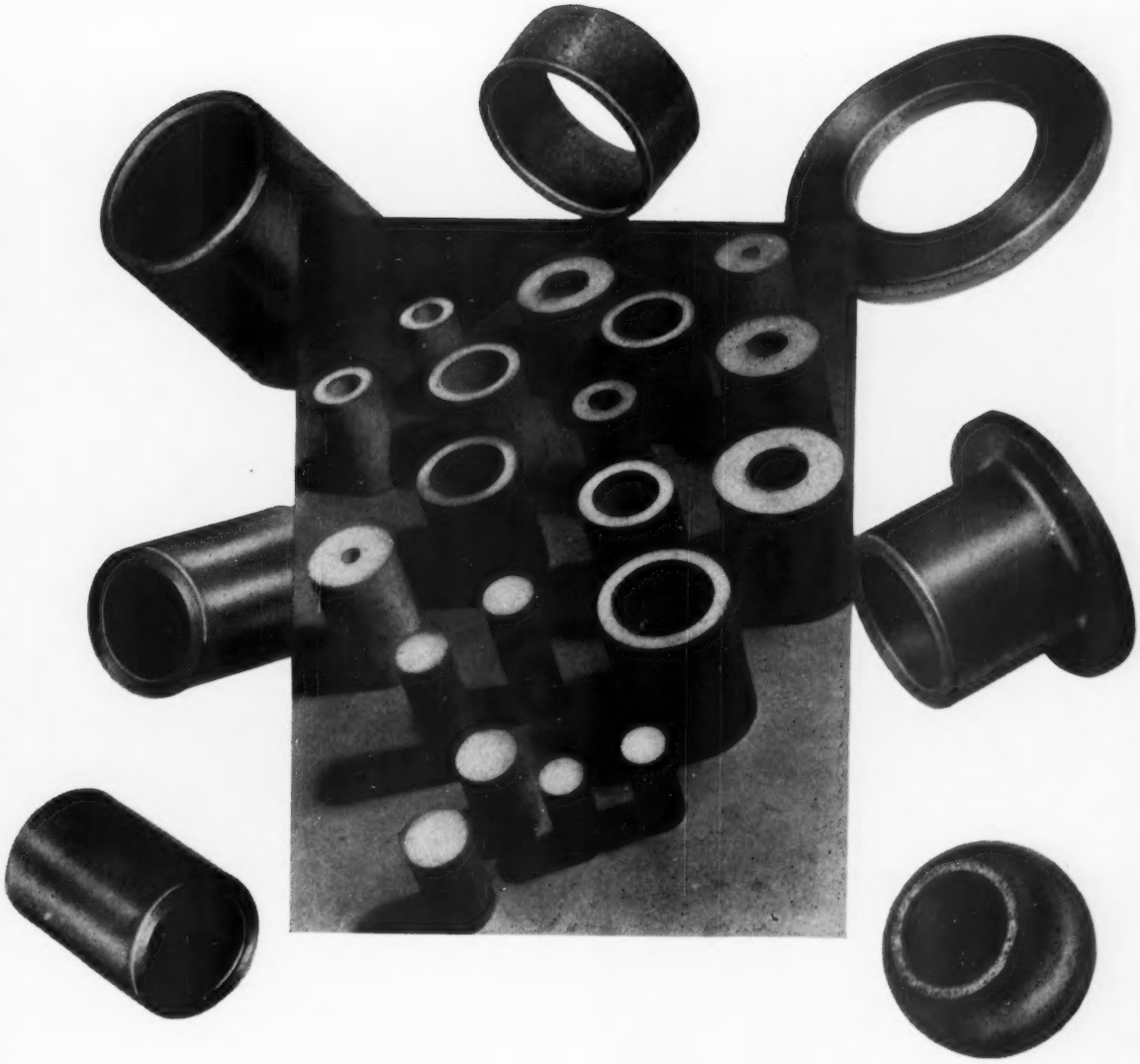
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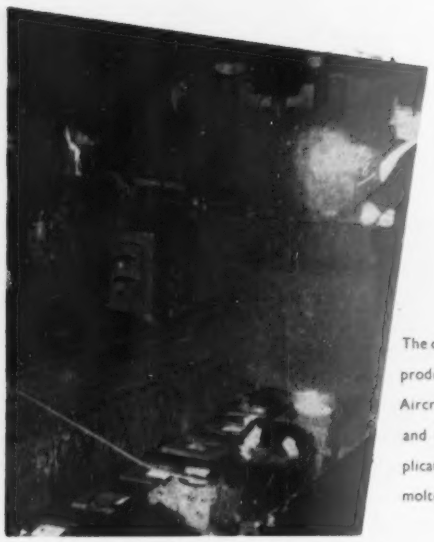
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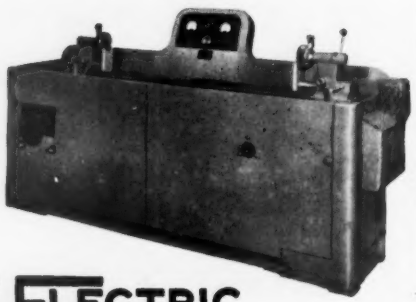
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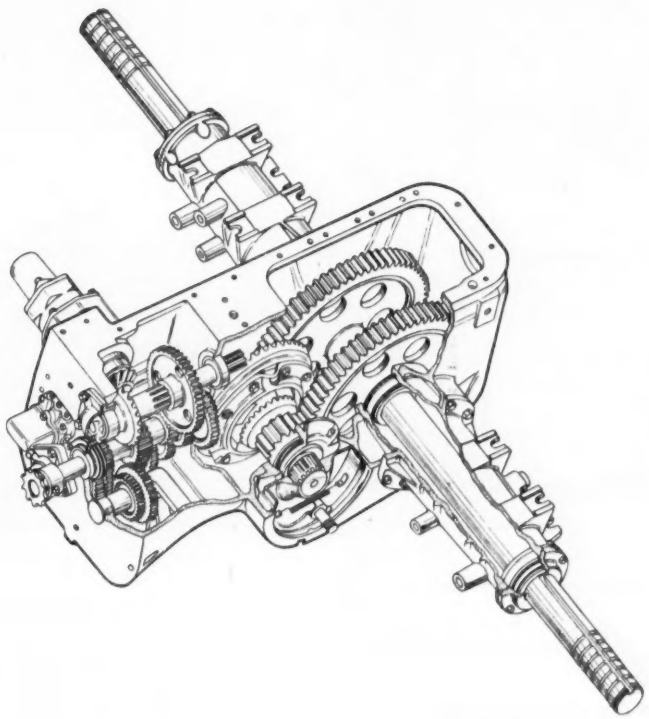


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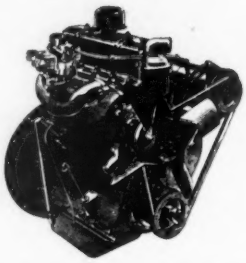
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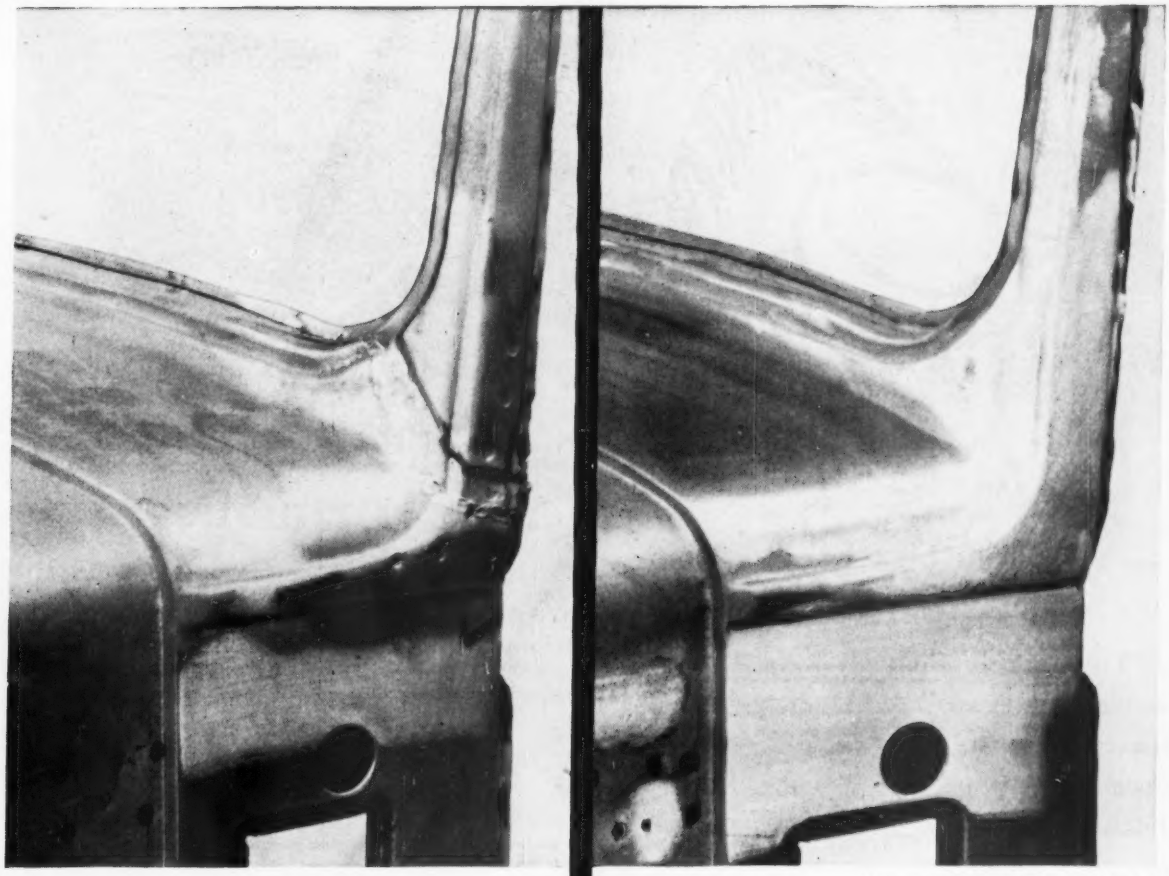
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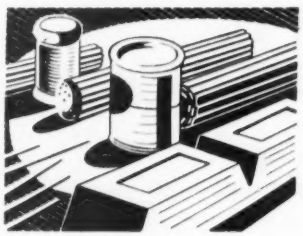
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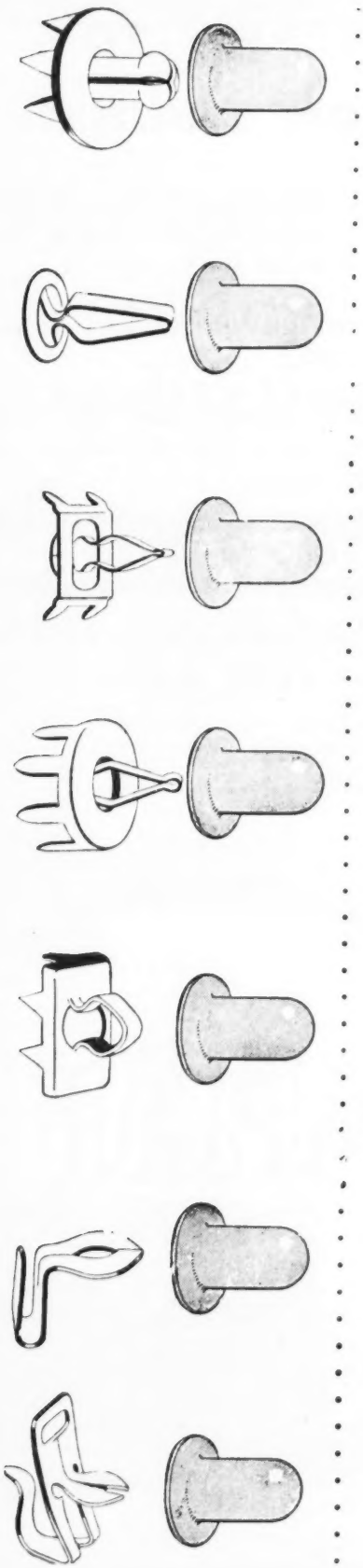


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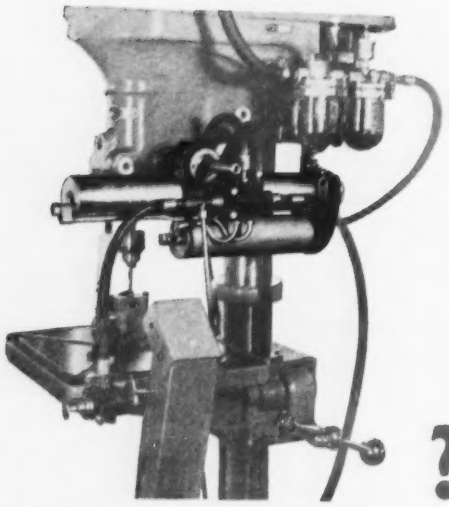
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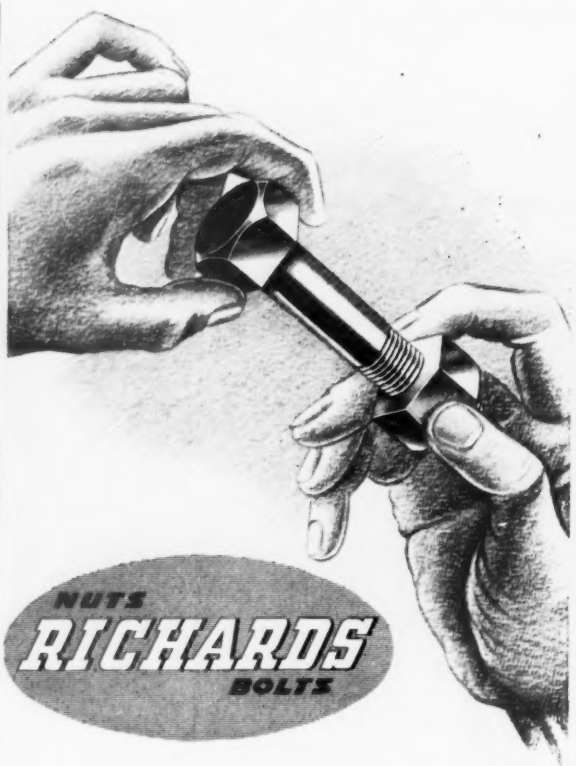
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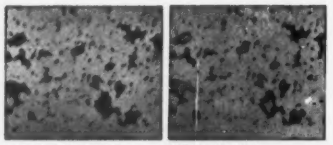


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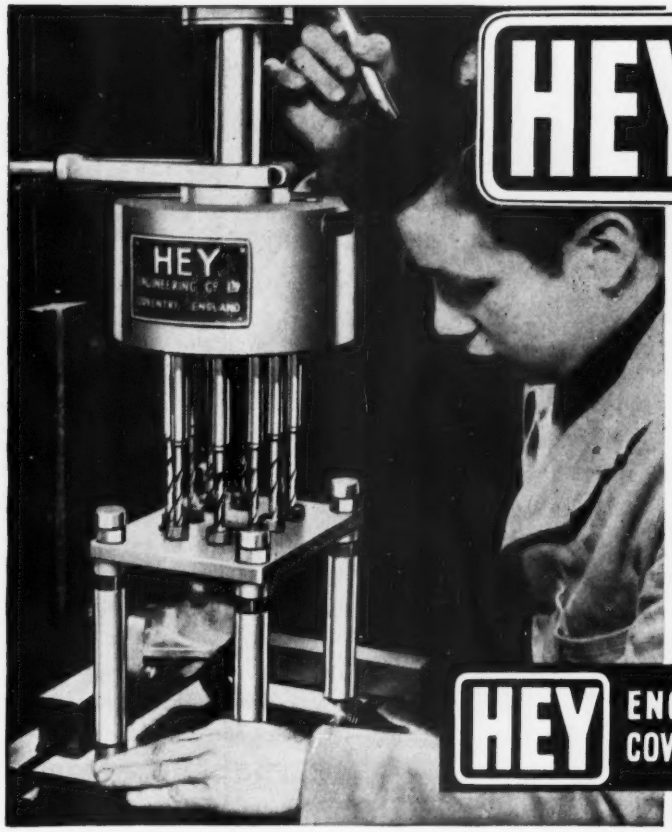
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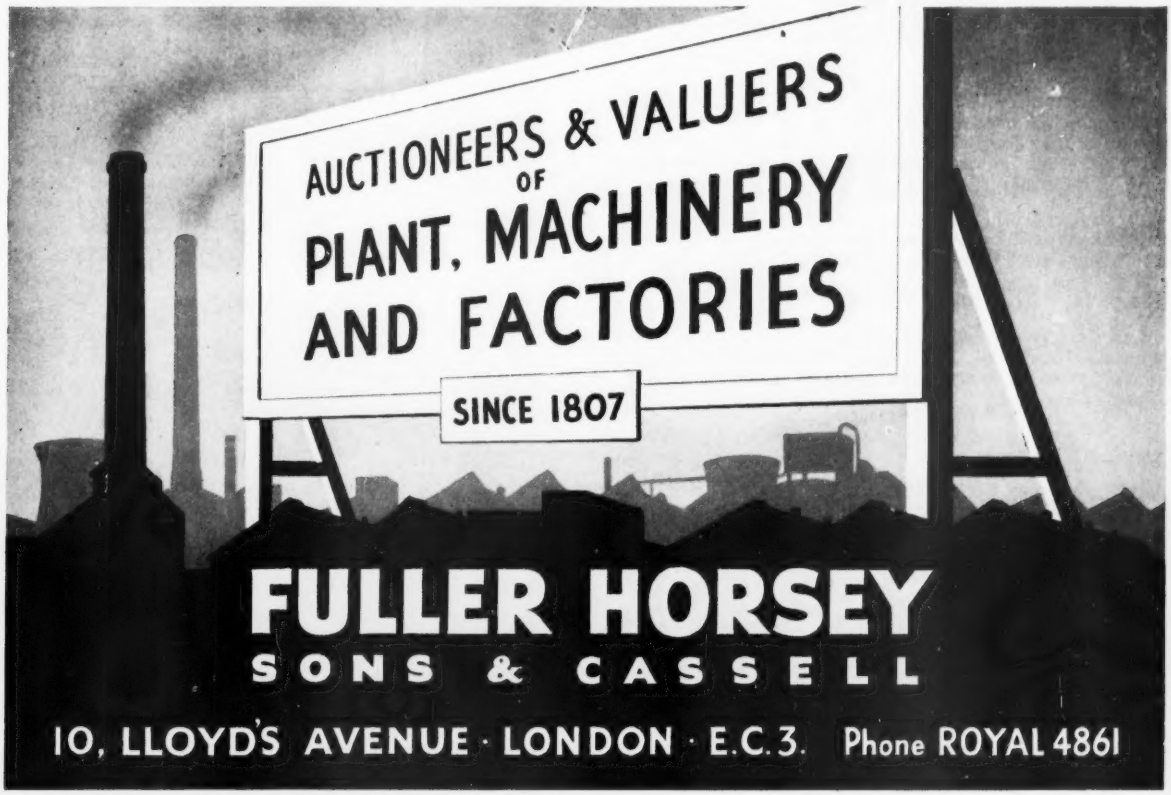
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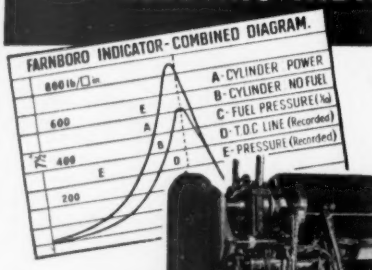
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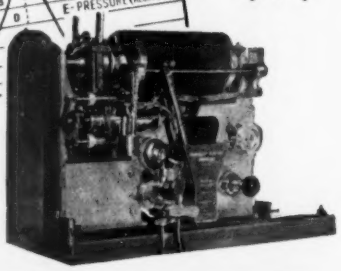
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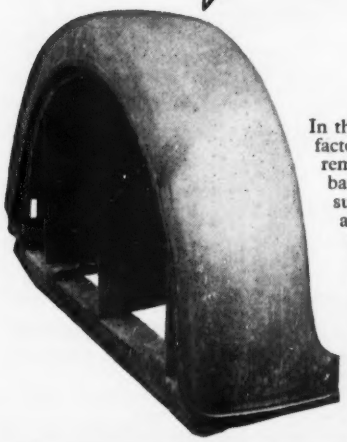
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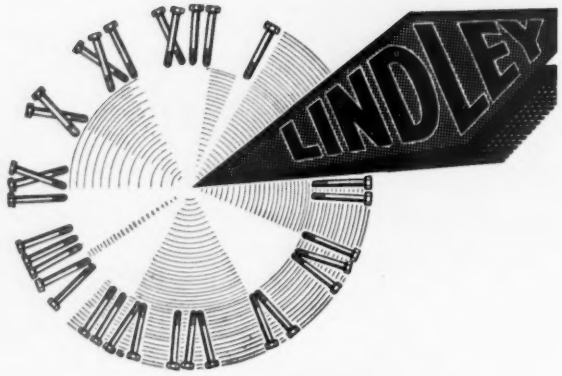


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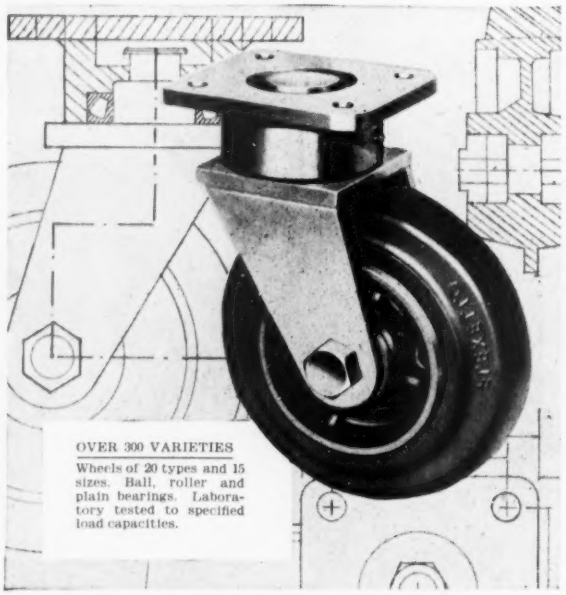
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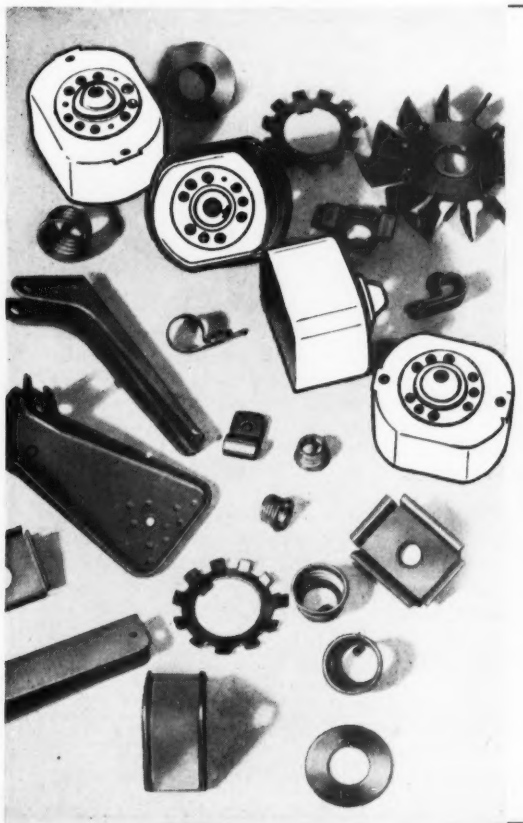
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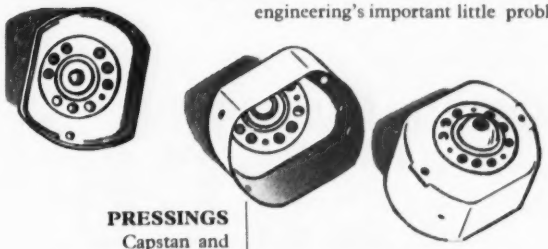
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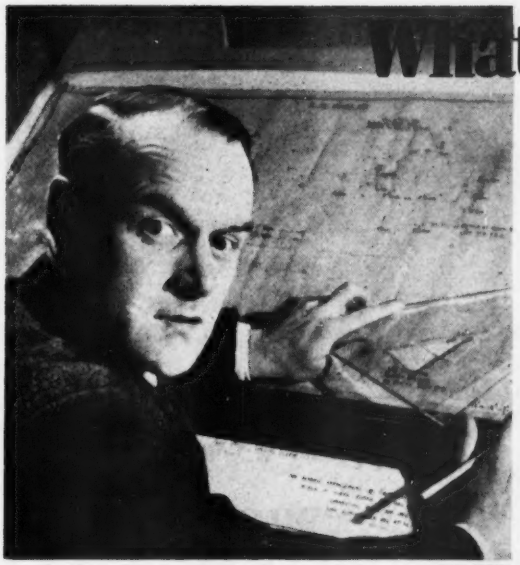
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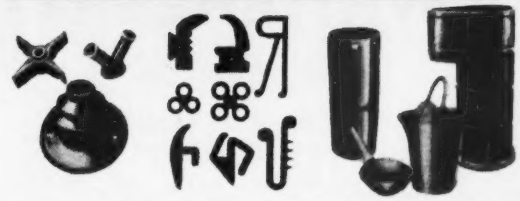
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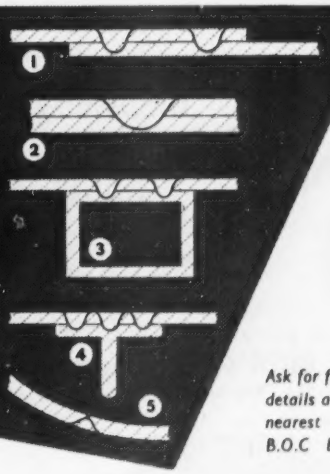
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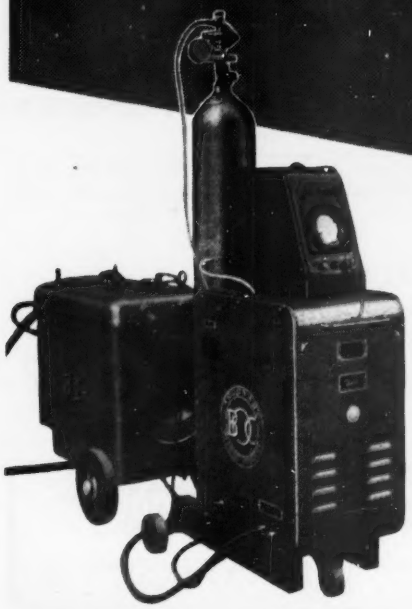
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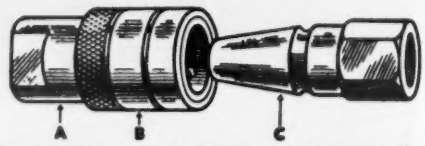
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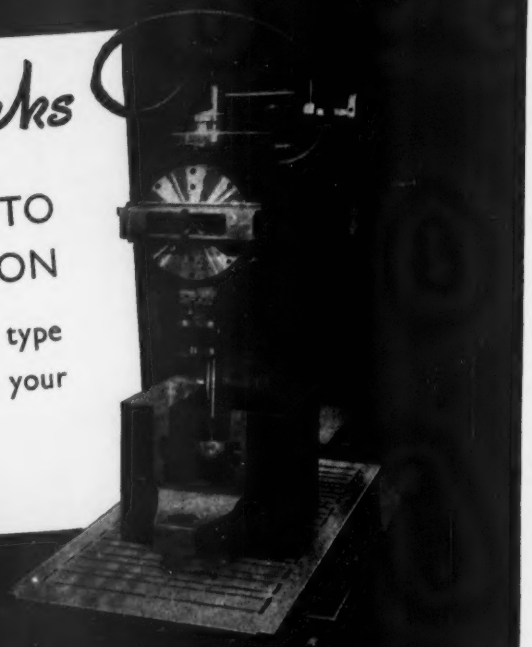
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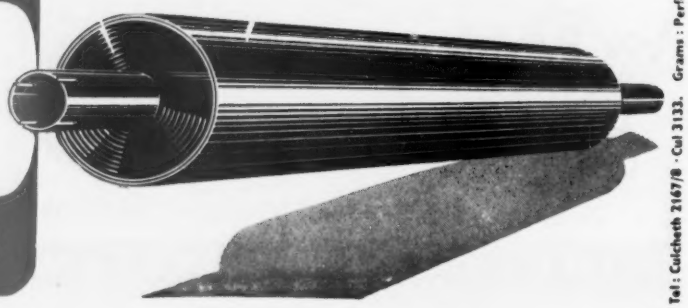
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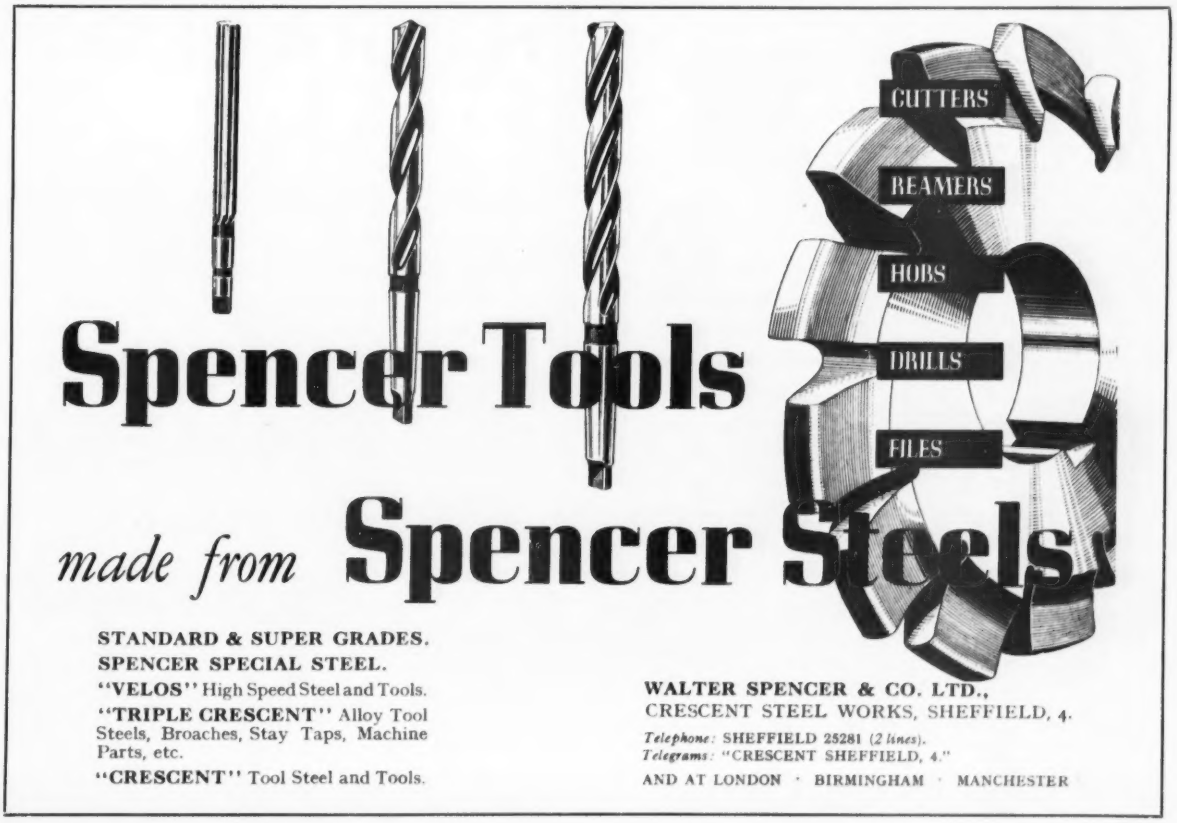


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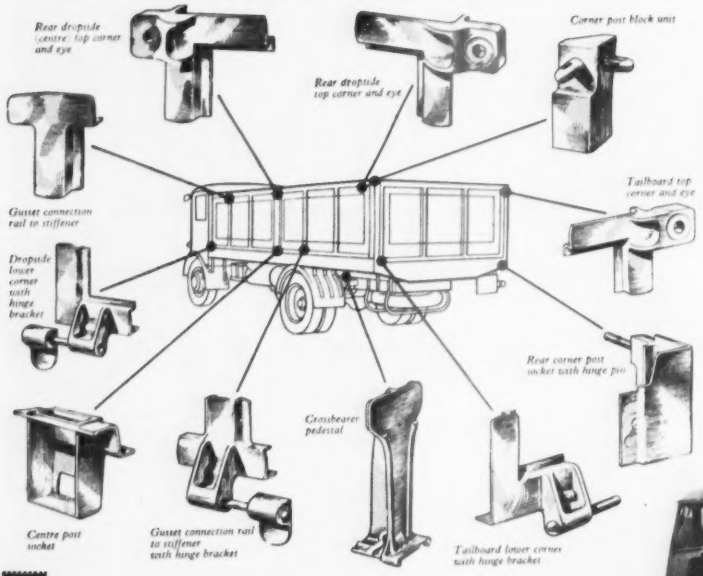
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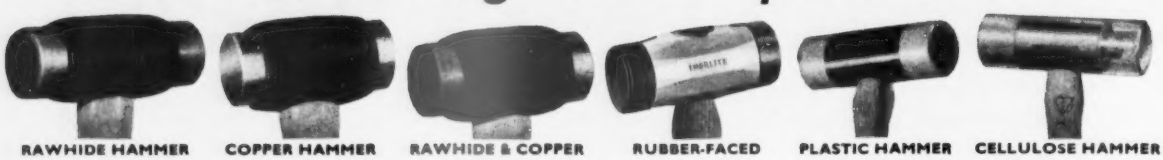
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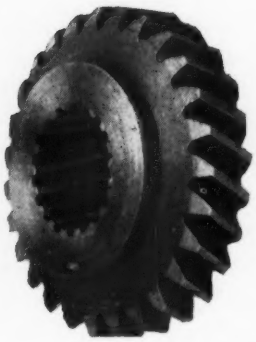


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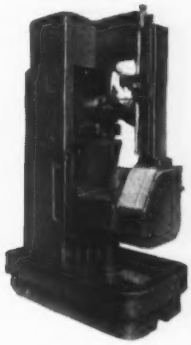
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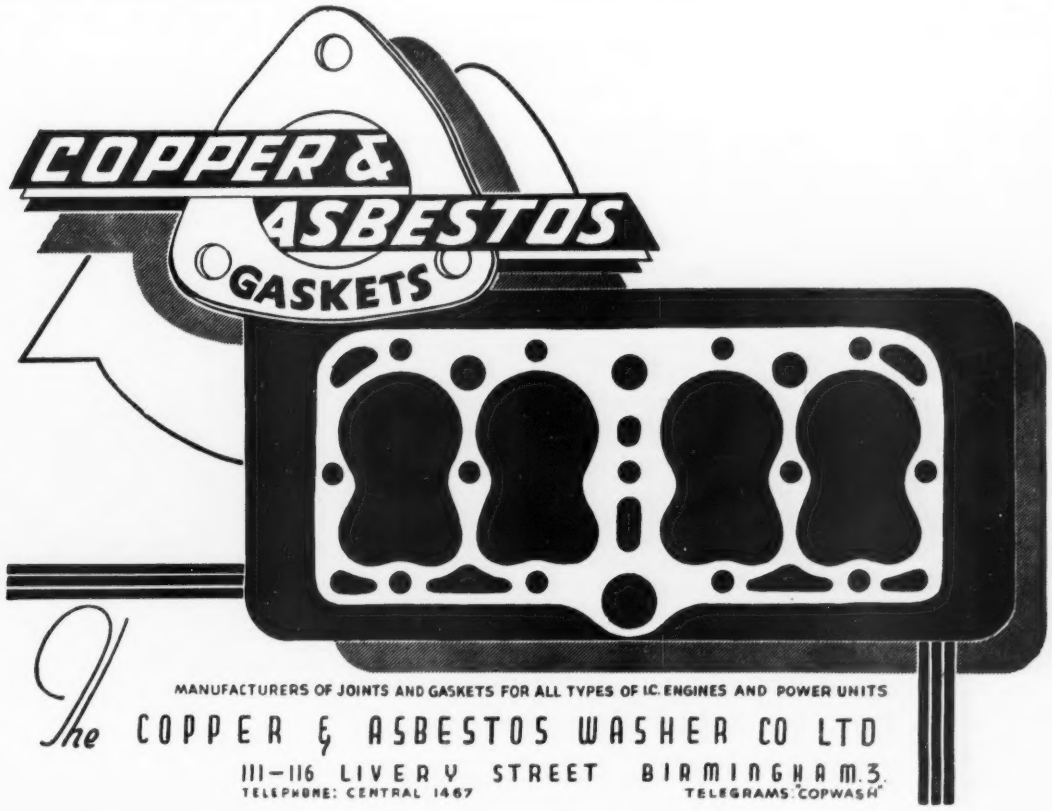
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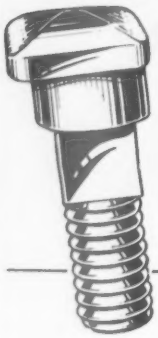
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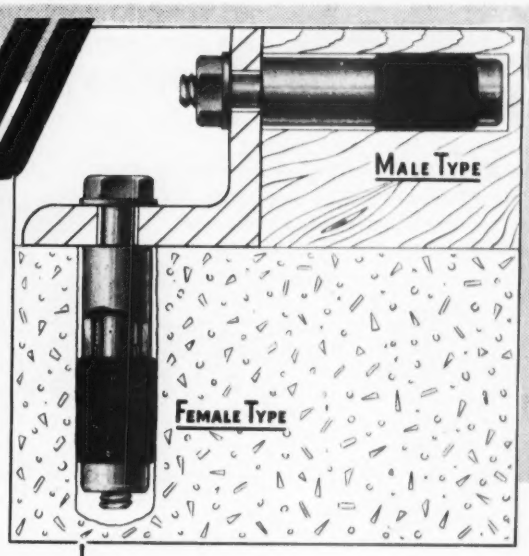
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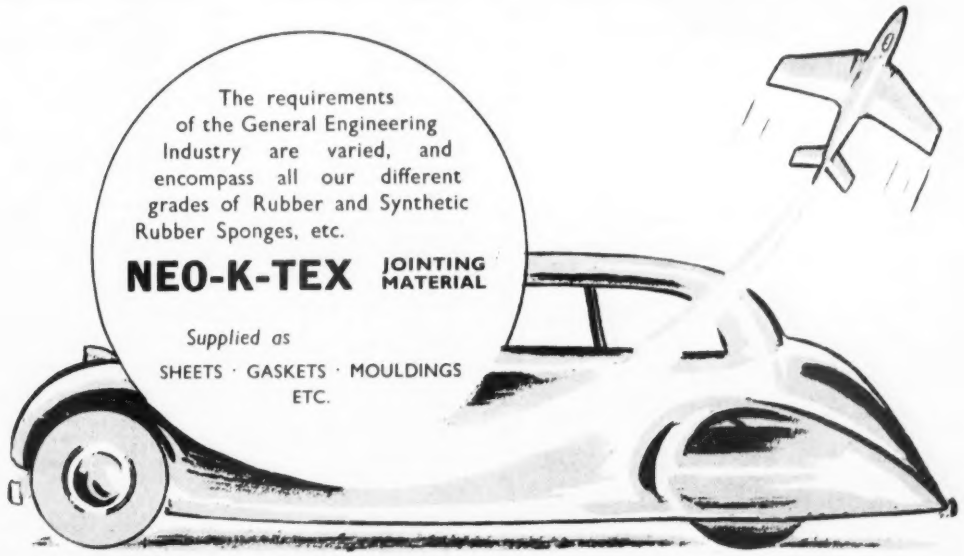
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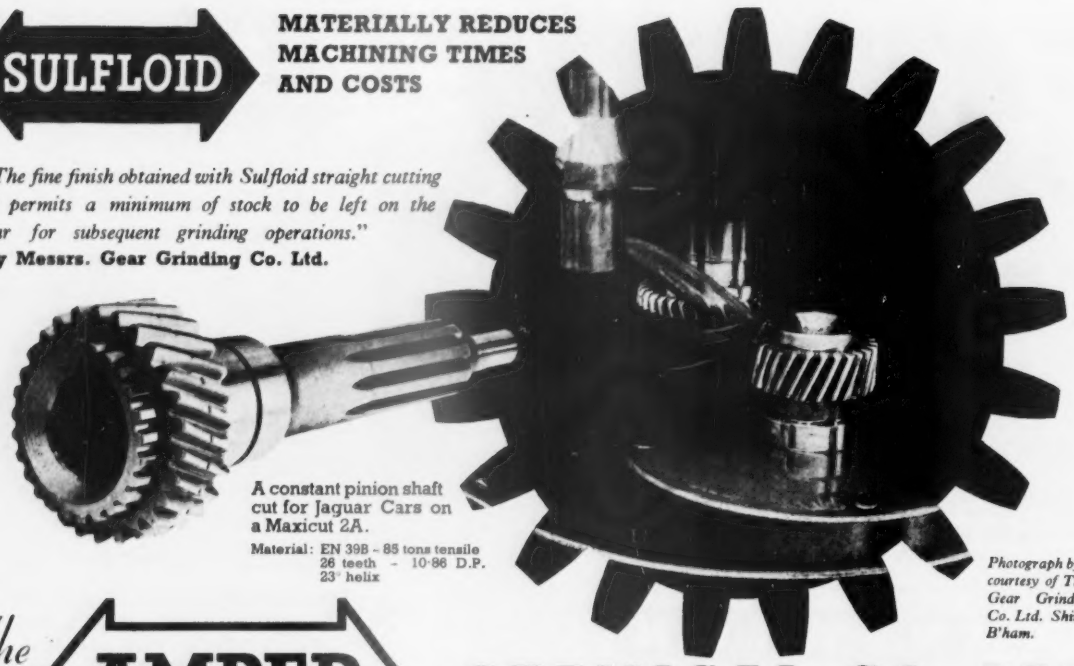
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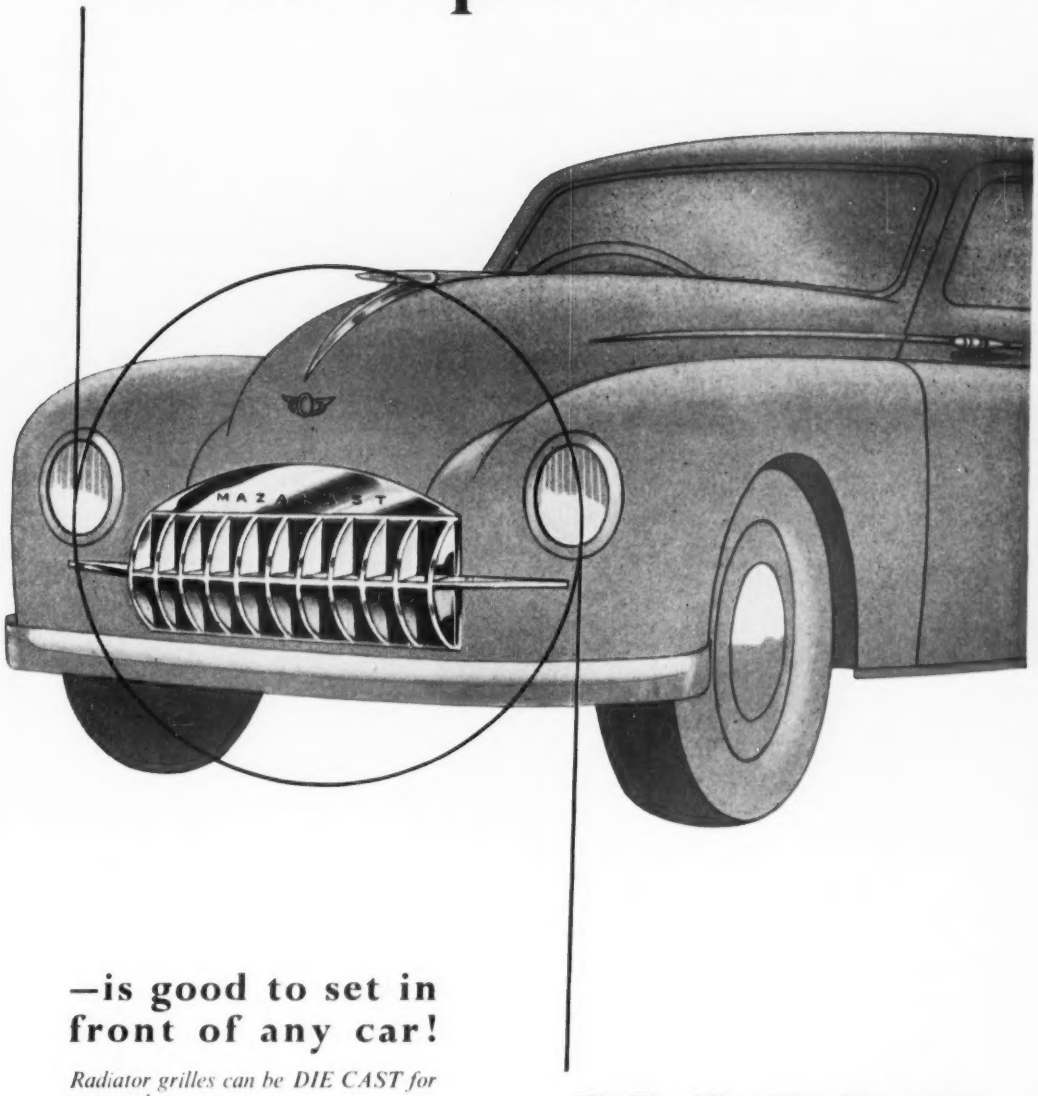
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